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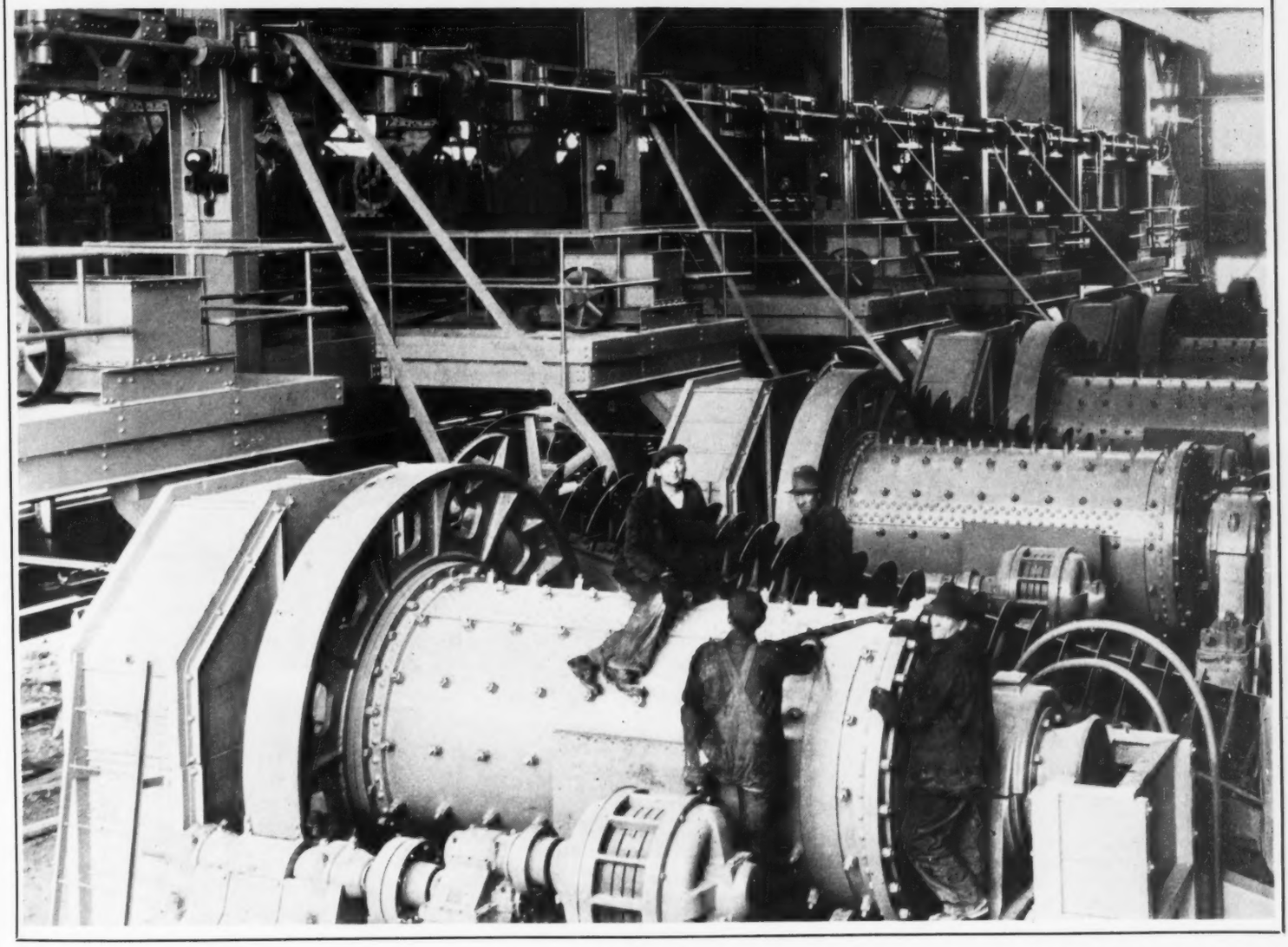


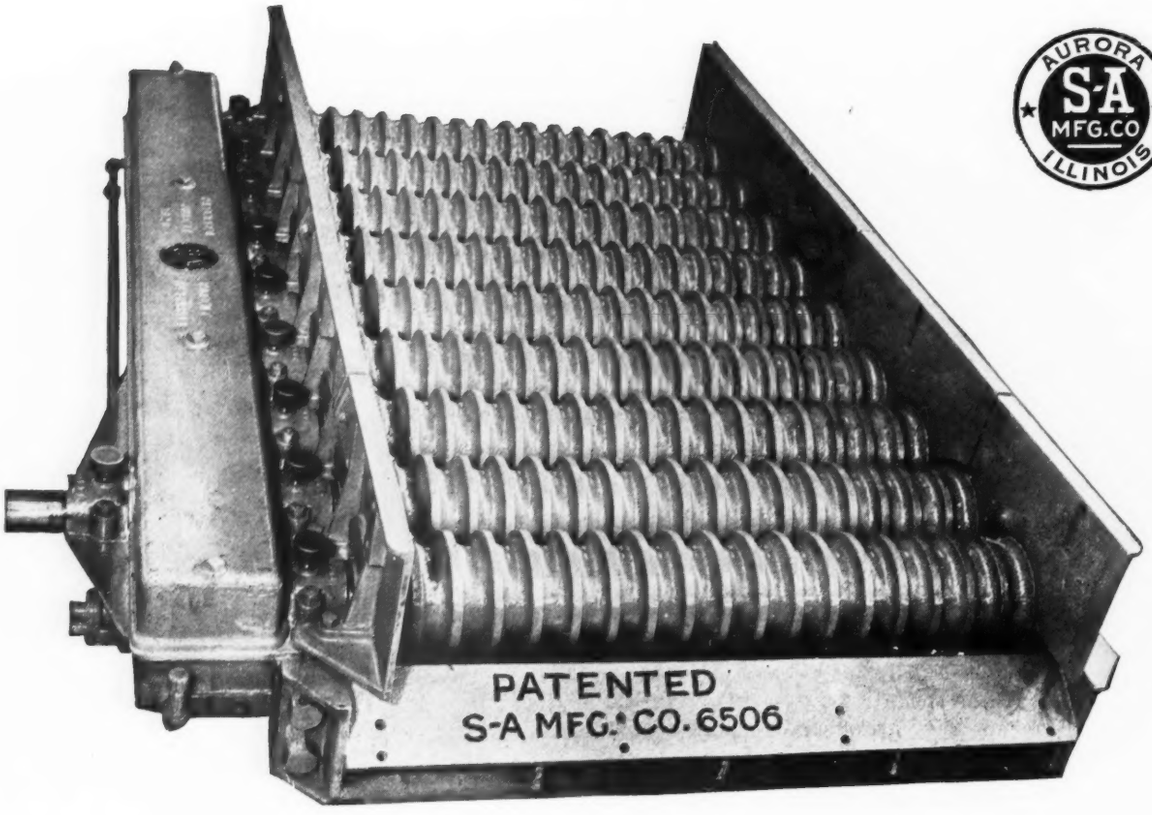
Grinding section of U. S. Smelting, Refining & Mining Co.'s new lead-zinc concentrator at Midvale, Utah

Design and Construction of the Midvale Mill
By J. F. Geary

Drilling and Blasting in United Verde's Open-Pit Mine
By C. E. Mills

Experiments on Solution of Tin Minerals
By John W. Gruner

Diamond Mining in 1925
By Sydney H. Ball



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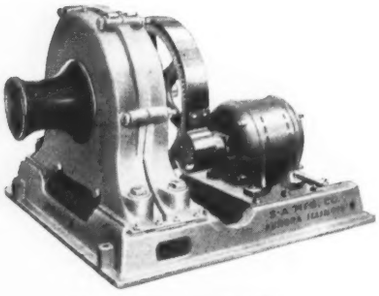

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Volume 121 New York, June 5, 1926 *Number* 23

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Contents

*Illustrated Article

Editorials 913
- Ore Deposition in the Tri-State District
- Tunneling in the Seventies and Today
- Mine Ventures of all Degrees
- Industrial Work for Engineers
- Achievement of Miami Copper
- Generosity to Employees

***Metallurgists of Note** 916
Colin Garfield Fink

***Design and Construction of the Midvale Mill** 917
By J. F. Geary

Possible Uses of California Black Sand 923

Solution of Tin Minerals Studied 924
By J. W. Gruner and S. C. Lin

Diamond Mining in 1925 925
By Sydney H. Ball

***Drilling and Blasting in United Verde's Open-Pit Mine** 928
By C. E. Mills

Discussion 932
- *A Small Meteor Crater in Texas
- Blue Sky and Red Blood
- Route to Red Lake
- Genesis of Sulphide Ores

Mining News 934
- Half a Million Dollar Tungsten Shipment
- Kirkland Lake Gold Camp
- Transvaal Mining Costs Reduced
- Oil Situation
- Washington News
- Letters from Toronto, London and Johannesburg

Men You Should Know About 941

Obituaries 941

Societies, Addresses and Reports 942

Recent Technical Publications 943

New Machinery 945

Markets 946

Metal Statistics 950

Company Reports 951

Mining Stocks 952

Searchlight Section 48-50

Professional Directory 51

What and Where to Buy 54

Advertising Index 58

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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

Volume 121 New York, June 5, 1926 *Number* 23

Ore Deposition in the Tri-State District

THE Joplin or Tri-State district, in southwestern Missouri and adjacent Oklahoma and Kansas, is the largest producing zinc-lead district of the United States, and, indeed, of the world. Its total past production has been very great, and the steady new discoveries that have been made warrant the expectation that much ore yet remains to be uncovered by assiduous exploration. Yet this remarkably extensive and rich district is without those satisfying geological peculiarities which serve as guides to the miner and engineer in most ore-bearing districts—features such as igneous intrusions, faults, and definite veins or vein channels. The rocks consist of Paleozoic limestones and shales, flat-lying. There are no igneous rocks, and only rare and insignificant slight faulting—usually neither warping nor displacement worthy of such designation. Under these circumstances it has been very difficult to arrive at any "theory" of ore deposition which could be generally acceptable. Yet this is what the present-day intelligent mining engineer and mine operator craves. It is far easier, however, to point out the arguments against any given theory than to put forth convincing reasons in its favor. In this respect it is like the Upper Mississippi (Illinois-Wisconsin) lead-zinc district, which in many ways, indeed, it strongly resembles. The analogy of the Joplin field with the Illinois-Wisconsin field is far closer than between the Joplin field and the southeast Missouri region, which is in a different class.

As a result, many successive geologists have done their best to point out a satisfactory working hypothesis for the Joplin region, but without consensus of opinion. One group sees in these vast and highly concentrated deposits the result of leaching from overlying strata, by descending surface waters, of metals contained in tiny quantities in the original sediments. Another group, pointing to the fact that the ores occur under a practically impervious shale formation (when this has not been stripped off by subsequent erosion) decide in favor of ascending solutions; and in view of the present existence of artesian waters, ascending under hydrostatic pressure, decide that such artesian waters, ascending laterally and upward, have performed the leaching from the same sources (the sedimentary strata) in much the same way. A third working hypothesis would be, accepting the evidence of ascending solutions brought forward by the supporters of the artesian water theory, that the ascending solutions which deposited the ores were not artesian waters, but were injected solutions—perhaps hot and perhaps concentrated—injected upward and laterally along the beds: which solutions at some past definite period entered the rocks and replaced the limestones along the definite system of fracture channels where the ore is now localized.

All of the available data must be re-examined and compared in judging between these three groups of conceptions. And apart from local data, it is evident that in spite of the unusual ore concentration here, the district is not a strongly marked geological type; so that in the question of its nature a broader field of geological phenomena must be investigated, and comparison made with the other ore districts which are nearest and which may have more definite diagnostic characteristics. For the present, two guiding principles may suffice—that the ore occurs principally in a certain sedimentary formation, and preferentially in certain layers of that formation; and that it follows an extensive system of fractures at right angles to one another (with little or no displacement) which form a network. The intersection of these nearly vertical fracture systems with the favorable beds produces the ore-runs. Another favorable indication is held to be the basins or cup-like depressions of the overlying shale down into the ore-bearing limestones; and development following this clew is reported to have given satisfactory results. In the latter case there is great argument as to whether the basin caused the ore or the ore caused the basin. The partisans of the first-named theory believe that the depression collected and concentrated the descending waters which brought and deposited the ore; those of the latter explanation, that shrinkage attendant upon the replacement and solution of limestone by ore-depositing solutions, and subsequent solutions, beneath the shale, caused the shale cover immediately above to sag or even locally to collapse.

Tunneling in the Seventies and Today

CONSTRUCTION of the new tunnel that the Lehigh Valley R.R. has decided to drive through Musconetcong Mountain, in New Jersey, parallel to the present Musconetcong tunnel, the building of which was begun in 1872, will afford an excellent chance to compare modern methods of tunneling with those of an earlier day. The old Musconetcong tunnel, still in use, is an historic piece of engineering. Next to the Hoosac tunnel, it was, at the time of its construction, the longest bore in the United States. More important than this, however, from the historic viewpoint, is the fact that it was the first tunnel in the construction of which modern American mechanical methods of tunneling were employed. Before its day American engineers had, rather slavishly, followed British methods of construction. Work on the Hoosac tunnel was begun with hand drills: it was only toward the finish of that bore that the compressed-air-driven machine drill was in-

troduced. Black powder was used for blasting. So it was not strange that its construction took more than twenty years.

A new era of tunnel building began with the driving of the Musconetcong bore. The air drill and air compressor, both of primitive design, were used throughout. Dynamite, then a new and little-known explosive, was substituted for black powder. Three years were required for construction. Henry S. Drinker was resident engineer in charge, and his detailed story of how the work was done was published in the *Engineering and Mining Journal* for May 29, 1875. At the west end of the tunnel, he says, four Burleigh compressors were used to run the drills. They consisted, each, of two vertical air cylinders run by a horizontal steam engine. The Ingersoll drill was used throughout, at first the 3½-in. machine, then the 4-in. and finally the 5½-in. drill being selected as best adapted for the hard rock met. "This style of drill," Mr. Drinker says, "was found to run for months with little or no repairing necessary." As to the dynamite used, Mr. Drinker says, "It is tremendously powerful, bringing out at a blast masses of rock that black powder could not even shake, and is invaluable for rapid driving in hard rock." Two strengths were used: one containing 75 per cent nitroglycerine and 25 per cent kieselguhr, and the other 36 per cent nitroglycerine and 64 per cent of potash, rosin, sulphur, and infusorial earth, having a relative strength of 68 per cent of that of pure nitroglycerine. It was following this experience on the Musconetcong tunnel that Mr. Drinker wrote his monumental work on tunneling, now antiquated.

Since the seventies, many improvements in tunneling practice have been made. Mechanical shovels and electric haulage have been developed for handling the broken rock; artificial ventilation has been perfected; compressors, drills, and steel have all been improved, as well as methods of breaking ground. So it will be interesting to watch the work of driving the new Musconetcong tunnel as it progresses, bearing the earlier job in mind. The comparison may furnish inspiration for equal or greater improvements in the future.

Mine Ventures of All Degrees

MINING CIRCLES of London were recently excited by a rumor that gold fields in Panama had been discovered that would rival the Rand, and a large issue of stock in a company to explore and exploit these fields was offered to and taken by the public. The peculiar thing about this supposedly spectacular discovery was that the news had apparently not reached New York, which, usually as keen as London to new mineral fields, did not evidence either excitement or interest. We are now informed by an engineer who has arrived from Panama, and who is financially interested in the gold possibilities of the region, that the London company in question has no discoveries of ore—simply a permit from the government to explore in a considerable partly prospected territory, in which are some properties belonging to earlier locators, of which our informant is one. In this light there would not seem to be any cause for undue excitement either in London or New York. While there have been instances, especially in Africa, where a permit to explore and locate has resulted richly for the enterprisers, yet exploration companies in general have usually been carried on safely under the protection of an operating and handsomely paying mine, the profits from which will cover the losses and allow the whole business to be respectably closed out, if the search for and trial of new properties does not flourish. Such an exploration enterprise, standing by itself, is hardly an ideal form of popular investment, though well enough for the surplus pennies of the well-to-do desiring to take a gamble. Would it not be well to acknowledge the sport and the lure of the latter operation frankly, and discriminate, in offering mining stock to the public, between business and sporting promotions? To be sure, as in all gambling operations, most of these now offered to the public, and often represented as the safest and most lucrative of investments, do not even offer a gambler's chance; for the cards are stacked and the wheel is weighted, so that the promoters win in any case. So there would seem to be an excellent opportunity for letting the public in on honest mining gambles; and we may look forward to the organization of some such concern as the Square Mine Gambles Incorporated, which should rouse the sportsmanship—not the greed—of the public by frank statement of the adventure involved, in which case the public would have a chance to participate in the romance and excitement of mining—and possibly its profits—to its heart's content.

Industrial Work for Engineers

THE PLAN of co-operative instruction in engineering, commerce, architecture, and other subjects was introduced at the University of Cincinnati by Dean Herman Schneider twenty years ago. The student, under this plan, divided his time between study in the college and practical and serious work in some factory or office, spending alternate periods in one and in the other. The plan is distinct from the shop practice or the laboratory practice of ordinary college institutions, in that the practical work done is part of the commercial program of the industrial establishment in which the student works and must be profitable to the establishment and to the student alike, who receives wages therefor, as an ordinary workman does. Students are arranged in pairs, and while one student is working on theory in the college his alternate takes his place in the factory, so that the practical industrial work goes on without interruption.

This idea has spread, and similar co-operative courses have been established in many colleges in the United States and in foreign countries. Among American colleges offering such courses are the Municipal University of Akron, Ohio; Antioch College, Yellow Springs, Ohio; the University of Detroit; Drexel Institute, Philadelphia; the Georgia School of Technology, Atlanta; the University of Louisville; Marquette University, Milwaukee; the Massachusetts Institute of Technology; the Newark Technical School, Newark, N. J.; the University of North Carolina; Northeastern University, Boston; University of Pittsburgh; Southern Methodist University, Dallas, Texas; University of Texas; and the University of Cincinnati. In June representatives from these colleges will hold a meeting in Cincinnati.

This decided trend among mechanical and electrical engineers, indicating that the student inclines to get his practice along with his theory, is reflected also among

mining engineers, by the large attendance of those mining schools centrally located in the United States close to centers of active mining, and the falling off of attendance in the mining schools in the great cultural university centers, whose actual contact with mining operations is difficult and not habitual. The theory that the engineer—as, for example, the mining engineer—should receive a broad cultural education before specializing upon his profession has met with what amounts to a repudiation by the prospective engineer, who has notably avoided attendance at colleges having this program. Yet in law and in medicine—even in business—educated and practical men have decided that the plan is not only admirable but almost necessary. At Harvard, for example, the schools of law, medicine, and business are all strictly graduate schools, but the engineer may finish his technical course without first being a graduate of the college. The hopes of engineers to put their occupation on a high professional plane, equal to that of law and medicine, thus appear difficult of realization. There is no doubt, apparently, as to the correctness of the theory and its desirability; but the modern youth will take a shortcut if he can; and if he is to enter one of the practical occupations, like that of engineering, his nature urges him to be in touch with tangible things and real industrial problems.

Achievement of Miami Copper

TO F. W. MACLENNAN, general manager, and his staff is due a tribute for the remarkable performance of the Miami Copper Co. in demonstrating the possibility of making a good profit from a sulphide ore, necessarily mined by underground methods, containing little precious metal and averaging less than 20 lb. of copper per ton. Of this only about 15 lb. can be practicably recovered by flotation concentration. The results summarized in the accompanying table are based on the treatment of nearly 900,000 tons of the low-grade ore during the final quarter of 1925; moreover, operation during the current year has been even more satisfactory, the ultimate cost being reduced virtually to 11c. per pound.

Commencing in 1913 with ore containing 50 lb. of copper per ton, mill heads gradually declined. Until this year the sulphide ore reserves have been divided into two classes: high-grade, averaging about 40 lb. of copper, and low-grade, averaging about 20 lb. Eighteen months ago, with less than a year's supply of the high-grade ore available for mining, and with work under way for increasing the capacity of the mine and concentrating plants, J. Parke Channing, the consulting engineer, published a statement of what the company modestly "hoped to achieve": a cost of 12.5c. on a basis of 10,000 tons of ore per day with a yield of 14 lb. per ton and an annual production rate of 50,000,000 lb. per year. Each of these estimates apparently has been surpassed.

The annual report for 1926 explains that the reduction in mining cost is due to the introduction of caving and closely controlled drawing, particularly applicable to high lifts—in this case 300 ft. The physical characteristics of the low-grade orebody evidently make it more suitable for this method of mining than were the higher-grade bodies. The increased tonnage and the consequent thinner spreading of overhead charges has also been a factor. However, no one doubts that most systematic and skillful organization in each phase of

Miami Copper Co.

	Year, 1924	Last Quarter, 1925
Ore reserves, Dec. 31, tons	40,034,000	67,917,000
Ore reserves, Dec. 31, copper content, pounds	22.75	20.20
Daily production, tons ore	6,808	9,600
Copper content of ore, pounds per ton	32.48	19.44
Mill recovery, per cent	80.17	75.79
Copper recovered, pounds per ton of ore	26.046	14.739
Annual production rate, pounds	63,658,000	52,684,000
Mining cost, per ton ore	$1.129	$0.442
Milling cost, per ton ore	$0.637	$0.528
Cost (to concentrate) per pound copper	$0.0823	$0.0777
Cost (to refined copper) per pound	$0.1233	$0.1187

mine operation has been essential. To mine ore by any method for $0.442 per ton requires that every man and every machine be utilized with the maximum efficiency. That is the test of *good* management as distinguished from mere management.

The large increase in ore reserves arises principally from the recalculation of the orebodies on the basis of a new minimum copper content for workable ore. This limit has been established by the actual demonstration that material of lower grade can be mined and milled profitably. At the proposed rate of 3,600,000 tons of ore per year, the present reserves should provide twenty years' additional life for the property; and the probability of large additions by further prospecting is excellent.

The reduction in milling cost is due principally to the increased tonnage handled; but here, too, corners have been cut. On the other hand, the recovery is not as good as it was in 1924. This is because of the increased proportion in the total copper content of minerals that are not readily amenable to flotation.

The Miami management found itself faced with two alternatives. One was to shut down and call the mine worked out; the other, to find a way to make money out of the low-grade sulphide ore, and perpetuate the enterprise. The only certain way of finding out whether the estimates as to the costs could or could not be realized was to enlarge the plant and give the plan a trial. The directors appropriated the necessary money; and the operating officials certainly have justified the confidence placed in them.

Possibly the fact that the entire staff realized that failure meant that they probably would be looking for a new job put additional enthusiasm into the work. Be that as it may, they have reason to be proud of their achievement.

Generosity to Employees

THE RECENT ACTION of the United Verde Copper Co. in voluntarily assuming an obligation to compensate one-half the losses of the company's employees who had accounts with two local banks that failed is only another instance of the interest taken by mining companies in the welfare of their employees. Good management accepts the fundamental that there is a direct connection between employer and employee, not only in the actual operation of an enterprise but also in the everyday affairs of the worker, apart from his job. The worker's interest in a going enterprise is vital, as continuity of employment and the success of any enterprise are dependent in a considerable degree upon his point of view.

Metallurgists of Note

Colin Garfield Fink

THE OLDER TYPE of college professor was essentially an instructor, and depended upon what he could learn from commercial life for his up-to-date pedagogical material; another type, one that is becoming much more common in our great universities, is essentially a commercial research man, one upon whom big industrial companies rely to keep them ahead of their competitors, who gives them information rather than obtains it from them, and who is perhaps only secondarily a teacher of college students. To the latter class belongs Colin G. Fink; in fact, Dr. Fink considers teaching, along with gardening and music, as one of his recreations. He has a group of graduate students at Columbia University and maintains his office there, but he is engaged in commercial research work most of the time. One does not at first associate Colin G. Fink with Lehn & Fink, the firm that introduced Pebeco toothpaste and other well-known toilet accessories into this country. This was his father's company, his father having come to America from Germany when a young man to escape military service. The family had been foresters for many generations, but on coming to New York the elder Fink secured employment with Eimer & Amend. Had it not been for his father's chance connection with this firm, it is unlikely that Dr. Fink would ever have been enrolled in the ranks of the country's metallurgists and chemists. Born in New Jersey on Dec. 31, 1881, he was educated in the New York City schools and was graduated from Columbia University in 1903, thereafter doing post-graduate work in physical chemistry at the University of Leipzig. Upon his return to the United States in 1907, he was employed first by the General Electric Co., and soon the first of his great achievements was announced. This was the commercial production of ductile tungsten and its utilization in incandescent lamps. This he introduced at the General Electric Co.'s Edison Lamp Works at Harrison, N. J., in 1910. One of the problems remaining to be solved was the development of a substitute for the platinum lead-in wires used in the lamps. Search had been made for a suitable substance of about the same coefficient of expansion as the glass in which it had to be fused, but it is characteristic of Dr. Fink that he began to work with an entirely different idea in his mind, and investigated substances that would form a close bond with glass at glass-making temperatures, relying on the elasticity of the wire-substance to avoid rupture of the weld. He finally devised an iron-nickel core, coated with copper or copper oxide, which served the purpose excellently and is still used, saving the former great expenditure for platinum and helping to make our present-day lamps cheap as well as efficient. The importance of this work is shown by the fact that 82 per cent of the net profits of the General Electric Co. in 1924 were made from the manufacture of electric lights. Dr. Fink then turned his energies to the development of an insoluble anode for the Chile Copper Co.'s plant at Chuquicamata. Lead, of course, is the material generally used, but there, nitric and hydrochloric acids are present, which makes the use of lead inadvisable. Finally a copper silicide anode was devised by Dr. Fink, supplementing ferrosilicon, which introduced undesirable iron into the solution. This has a catalytic surface of lead and manganese peroxides. The new anode obviated extensions to the power plant that would have cost several million dollars, and has reduced anode maintenance costs by about a million dollars a year.

COLIN GARFIELD FINK

With Charles H. Eldridge, Dr. Fink has recently developed the "Crodon" process for the electrodeposition of chromium, which has great possibilities, and he is also working on the extraction and use of tantalum as a substitute for the expensive and fragile fused silica, where hydrochloric acid must be combated. He is, in addition, working on the leaching of blende, the electrolytic refining of copper, precipitation of copper from tailing waters, and several other metallurgical problems. His success as an electro-metallurgist has made his services greatly in demand. He has had many honors and is a member of several clubs and societies.

Dr. Fink married Charlotte K. Muller in 1910, and they have two boys, aged ten and fourteen.

Design and Construction of the Midvale Mill

New Lead-Zinc Concentrator of the U. S. Smelting, Refining & Mining Co., in Utah, Embodies Many New Features Owing to Development of Selective Flotation—Custom Ores Treated

By J. F. Geary
Mill Engineer

J. F. Geary

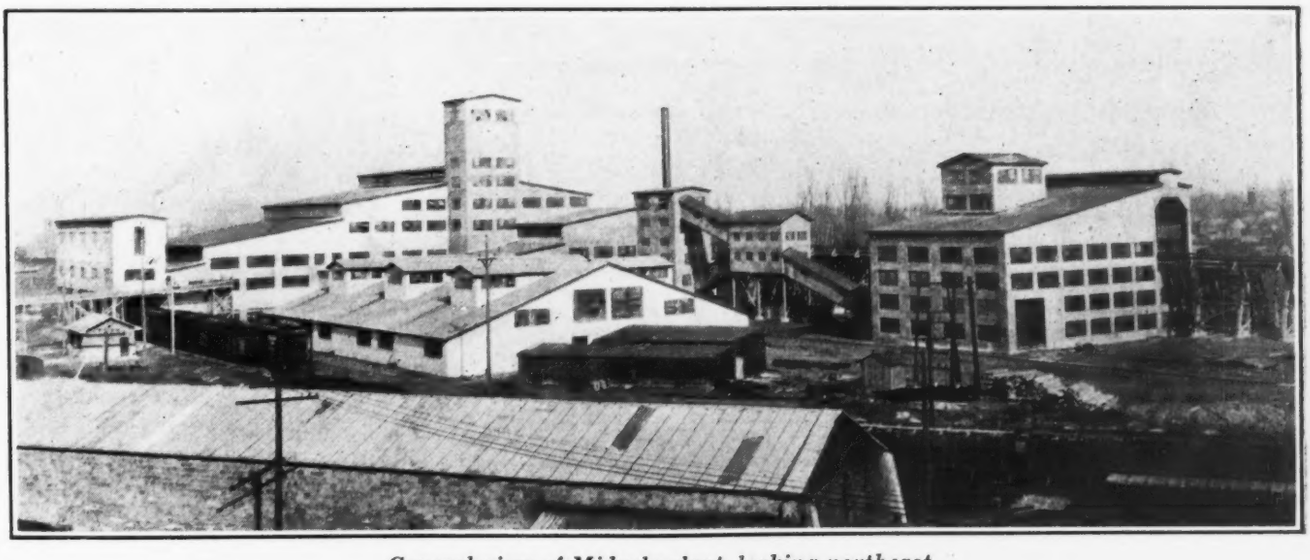
THE United States Smelting, Refining & Mining Co. operates, among other properties, the United States Mines, at Bingham, Utah. Since 1904, ores from these mines, as well as ores from other properties in the intermountain district, have been milled at Midvale in a combined electrostatic and gravity concentration plant. In April, 1924, a twenty-five ton experimental flotation plant was started on selective flotation of lead-zinc ores. Results obtained in experimental work were successful, and in December, 1924, decision was made to adopt the flotation process. Since the old mill buildings were too small to house the desired flotation equipment and too dilapidated to warrant remodeling, an entirely new plant was required. It was decided to have the new plant of the most modern design and to make it flexible enough to handle not only the company's own ores but any other ores that might be purchased to feed it.

Ground in the vicinity of the United States Mines, at Bingham, was first investigated for mill-site possibilities, but difficulties in the form of insufficient ground space, inadequate water supply, and expensive railroad construction soon caused a shift of the search to Midvale. There a small area of sloping ground, between bench land and Jordan River bottom land, was carefully considered. The area of this ground was hardly large enough to accommodate the sizable plant to be built upon it; the site was not easily reached with necessary railroad tracks; tailing storage space was limited; and in addition to these undesirable features the headroom available was insufficient to allow gravity flow through the mill. For these reasons, consideration of the sloping site was abandoned and decision made to build on the flat bench land in an area contiguous to the yard tracks, near the old mill, one-half mile south of the United States smelter at Midvale.

A wooden trestle of open stringer construction, 1,300 ft. long, built on a 2.26 per cent grade and a 7 deg. 14 min. curve, leads from the plant tracks to the crushing-plant receiving bin. Since custom ore is paid for as received, so that bin storage ahead of the crushing plant is impracticable, the crushing-plant bin is designed as a self-cleaning receiving bin only, not as a storage bin. The bin is 45 ft. long—long enough to accommodate one ore car—and holds 150 tons of ore. It is double hoppered, each hopper being an inverted pyramid with sides sloping at an angle of 12 in. vertical to 7 in. horizontal.

Each bin hopper is provided with a hand-operated arc gate mounted in a steel discharge chute. The ore in each chute rests upon a 36-in. manganese-steel pan conveyor. The two pan conveyors head toward the center line of the bin, at which point they discharge. A woodpicker's stand is placed here with start-and-stop push-button stations for each pan conveyor within easy reach.

Pan conveyors are chain driven, through Foote spur-gear speed reducers, by 7½ hp., Type MT, Form C, variable-speed, General Electric motors, with drum controllers, by means of which the travel of the pans may



General view of Midvale plant, looking northeast

be regulated from a speed of 1.5 to 6.4 ft. per minute. In operation, arc gates are opened to their fullest extent to minimize the possibility of ore hanging up in bin discharge openings, and the rate of ore discharge from the bin is controlled by the speed of conveyor.

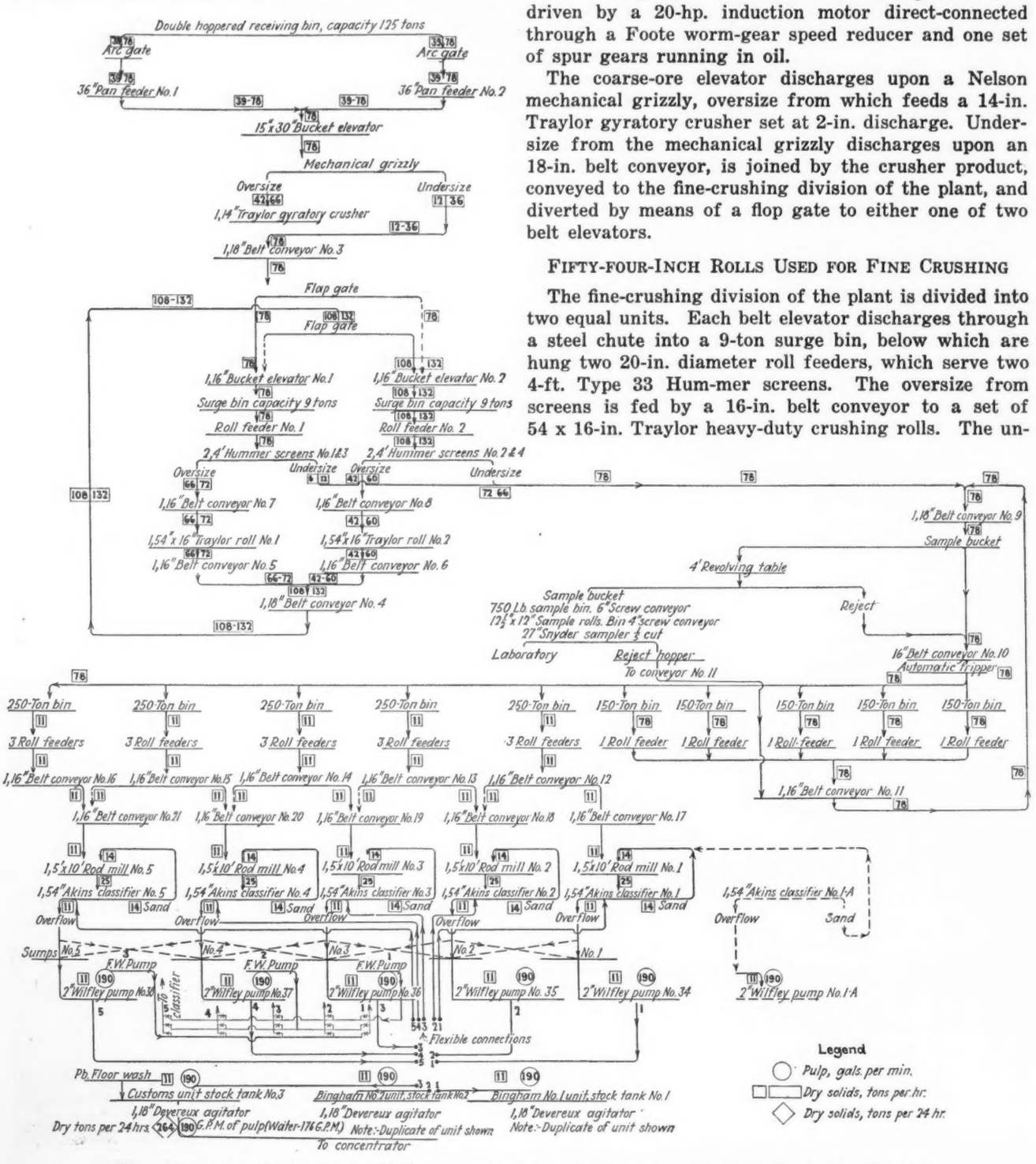
Bucket Elevator Preferred to Railroad Trestle

Both pan conveyors discharge through a steel chute into a coarse-ore elevator. Considerable thought was given to plant arrangement before the use of this equipment was decided upon. Topography of the site and existing railroad-track arrangement, however, allowed only one alternative—a long trestle, with excessively sharp curvature and steep grades. The elevator was selected as the lesser of two evils. The one installed is of the continuous-bucket type, each bucket discharging over the back of the preceding one. Buckets are 30 in. long by 15½ in. wide by 17¾ in. deep, the bottoms being made of $\frac{5}{16}$-in. steel plate and the sides of ¼-in. steel plate with a steel reinforcing strip across the feed edge. Buckets are bolted to Simplex manganese-steel chain on 18-in. pitch. Head-and-tail sprockets are manganese steel. The bucket line travels at the rate of 40 ft. per minute. The elevator is 39 ft. long, is inclined at an angle of 14 deg. from vertical, and is mounted in a steel tower arranged to be housed with steel plate. It is driven by a 20-hp. induction motor direct-connected through a Foote worm-gear speed reducer and one set of spur gears running in oil.

The coarse-ore elevator discharges upon a Nelson mechanical grizzly, oversize from which feeds a 14-in. Traylor gyratory crusher set at 2-in. discharge. Undersize from the mechanical grizzly discharges upon an 18-in. belt conveyor, is joined by the crusher product, conveyed to the fine-crushing division of the plant, and diverted by means of a flop gate to either one of two belt elevators.

Fifty-four-Inch Rolls Used for Fine Crushing

The fine-crushing division of the plant is divided into two equal units. Each belt elevator discharges through a steel chute into a 9-ton surge bin, below which are hung two 20-in. diameter roll feeders, which serve two 4-ft. Type 33 Hum-mer screens. The oversize from screens is fed by a 16-in. belt conveyor to a set of 54 x 16-in. Traylor heavy-duty crushing rolls. The un-


Double hoppered receiving bin, capacity 125 tons
Arc gate
Arc gate
36" Pan feeder No. 1
36" Pan feeder No. 2
15" x 30" Bucket elevator
Mechanical grizzly
Oversize
Undersize
1,14" Traylor gyratory crusher
1,18" Belt conveyor No. 3
Flap gate
Flap gate
1,16" Bucket elevator No. 1
1,16" Bucket elevator No. 2
Surge bin capacity 9 tons
Surge bin capacity 9 tons
Roll feeder No. 1
Roll feeder No. 2
2,4' Hummer screens No. 1 & 3
2,4' Hummer screens No. 2 & 4
1,16" Belt conveyor No. 7
1,16" Belt conveyor No. 8
1,54" x 16" Traylor roll No. 1
1,54" x 16" Traylor roll No. 2
1,16" Belt conveyor No. 5
1,16" Belt conveyor No. 6
1,16" Belt conveyor No. 4
1,18" Belt conveyor No. 9
Sample bucket
4' Revolving table
Sample bucket
750 Lb. sample bin. 6" Screw conveyor
12½" x 12" Sample rolls. Bin 4' screw conveyor
27" Snyder sampler ⅓ cut
Reject
Laboratory
Reject hopper
To conveyor No. 11
16" Belt conveyor No. 10
Automatic Tripper
250-Ton bin
3 Roll feeders
150-Ton bin
1 Roll feeder
1,16" Belt conveyor No. 16
1,16" Belt conveyor No. 15
1,16" Belt conveyor No. 14
1,16" Belt conveyor No. 13
1,16" Belt conveyor No. 12
1,16" Belt conveyor No. 11
1,16" Belt conveyor No. 21
1,16" Belt conveyor No. 20
1,16" Belt conveyor No. 19
1,16" Belt conveyor No. 18
1,16" Belt conveyor No. 17
1,5' x 10' Rod mill No. 5
1,5' x 10' Rod mill No. 4
1,5' x 10' Rod mill No. 3
1,5' x 10' Rod mill No. 2
1,5' x 10' Rod mill No. 1
1,54" Akins classifier No. 5
1,54" Akins classifier No. 4
1,54" Akins classifier No. 3
1,54" Akins classifier No. 2
1,54" Akins classifier No. 1
1,54" Akins classifier No. 1-A
Overflow
Sand
Sumps No. 5
No. 4
No. 3
No. 2
No. 1
F.W. Pump
2" Wilfley pump No. 38
2" Wilfley pump No. 37
2" Wilfley pump No. 36
2" Wilfley pump No. 35
2" Wilfley pump No. 34
2" Wilfley pump No. 1-A
To classifier
Flexible connections
Pb. Floor wash
Customs unit stock tank No. 3
Bingham No. 2 unit stock tank No. 2
Bingham No. 1 unit stock tank No. 1
1,18" Devereux agitator
Dry tons per 24 hrs.
G.P.M. of pulp (Water-17 G.P.M.)
Note:-Duplicate of unit shown
To concentrator
Legend
Pulp, gals. per min.
Dry solids, tons per hr.
Dry solids, tons per 24 hr.

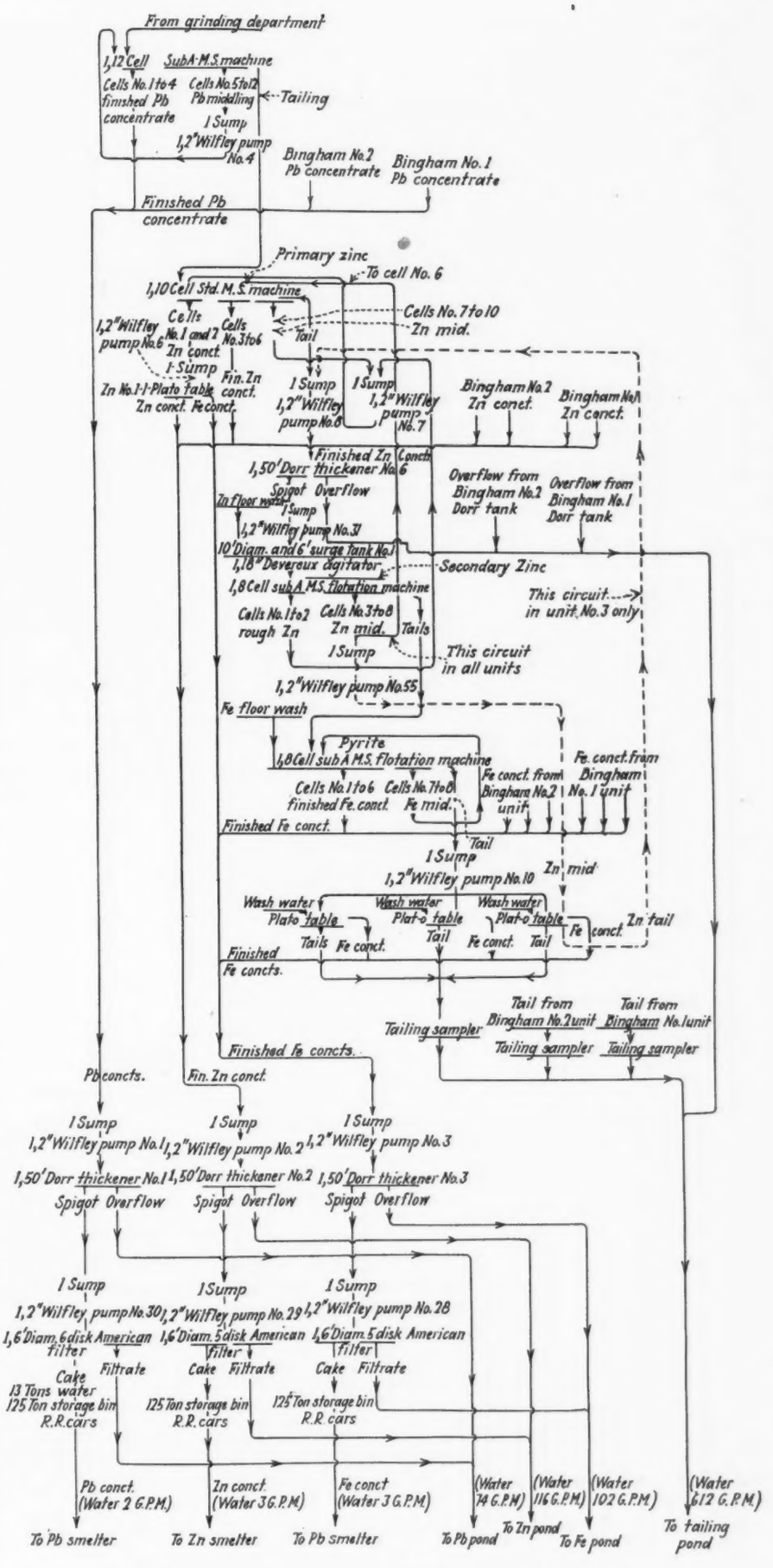
Flow sheet of crushing and grinding departments, showing quantities involved. See legend

dersize from screens in both units falls to an 18-in. belt conveyor and is transported to mill storage bins via the sample mill. Roll product is returned to screens by a conveyor system, both roll products being carried by the same belt. Discharge from this belt may also be diverted, by a flop gate, to either one of the two belt elevators referred to above. This arrangement permits the fine-crushing division of the plant to be operated as a two-stage plant, one side on coarse, the other on fines, or as a single-stage plant. In two-stage operation, the flop gates at conveyor discharges allow reversal of feed between the two units—that is, either unit may be changed from coarse crushing to fine crushing, or vice versa. In single-stage operation one side of the plant is down. The installation of one short additional conveyor, however, would permit both sides to operate simultaneously as two single-stage crushing units.

Each set of rolls is driven independently by a 75-hp., Type I, Form M, 450 r.p.m., General Electric motor. Roll pulleys are belted to a line shaft, which is in effect an extension of the motor shaft, being direct-connected thereto by an Ajax flexible coupling. All bearings on these shafts are Dodge-Timken roller bearings.

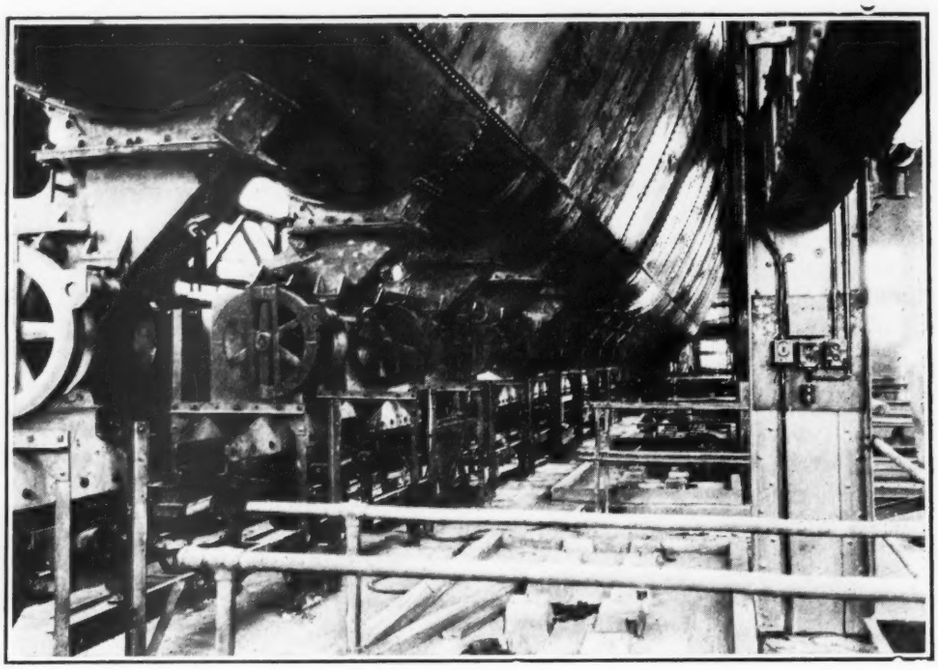
The capacity for which the crushing plant was designed is 600 tons in eight hours.

Crushed ore is transported from crushing plant to mill by an 18-in. belt conveyor, level at its tail end but inclined near its discharge end at an angle of 18 deg. The discharge end of the conveyor is on the top floor of a concentrator building wing which houses the sample mill. At the head of this conveyor (No. 9), a chain-and-bucket sampler is installed. The sampler is unusual in the small amount of headroom and floor space that it occupies, these being conserved by looping the chain line back, after the manner of a conveyor-belt tripper, and utilizing the same bucket for both first and second cuts. The second cut from the sampler is directed, by a padlocked slide gate, into either compartment of a double-hoppered bin, from which it is fed by a screw feeder to a set of 12 x 12-in. crushing rolls. The final sample is cut



Flow sheet of concentrating and dewatering units

by a Snyder sampler, keyed to the end of, and revolving with, a short screw feeder which is housed in the bottom of the sample-roll discharge hopper. On the final sample floor are the pulverizers, bucking boards, and drying cabinets. Reject from the final sample is chuted into a small hopper, which, having hinged lids set flush with the bucking-room floor, provides a convenient means of disposal of bucking-room clean-up. The hopper may be discharged upon the reclaiming conveyor from the custom-ore stock bins, and its contents thus easily carried back into the mill storage-bin system.



Roll feeders to rod mills. Three feeders are provided for each bin compartment

Storage Bins Adapted for Custom Ores

Discharge from No. 9 conveyor, together with reject from the chain-and-bucket sampler, falls to conveyor No. 10, a tripper-belt conveyor which loads the mill storage bins. This bin, designed especially for custom ore handling, is somewhat different from the usual run of mill bins. In cross-section the bin is a catenary. Longitudinally, it extends not only across the head of the rod-mill section but also across the head of the rod-mill repair bay. The portion of the bin across the head of the repair bay is divided by steel partitions into five compartments of 150 tons' storage capacity each. These compartments are provided for the storage of custom ore after it has been crushed and sampled. Below each custom ore storage compartment is hung a roll feeder, which discharges upon a 16-in. belt conveyor. This conveyor heads toward the crushing plant and rises at its head end to discharge upon conveyor No. 9 from crushing plant to mill. Inasmuch as conveyor No. 9 discharges upon conveyor No. 10, which loads all bin compartments, the contents of any custom ore storage compartment may be conveyed to any rod-mill feed compartment for feed to the grinding units. Custom ore mixtures may be made and the mixture sampled if desired.

The portion of bin across the head of the rod-mill section is divided by steel partitions into five rod-mill feed-bin compartments, of 250 tons' ore-storage capacity each. The partitions forming these compartments are midway between bin supporting columns, one partition on the center line of each rod mill. Each bin compartment is supplied with three roll feeders set 7 ft. 3 in. on centers—close enough to make each compartment very nearly self-cleaning. Each set of three feeders discharges upon a short gathering conveyor, which in turn discharges upon either one of two rod-mill feed conveyors, the gathering conveyor being made reversible by a reversing switch on the motor. This arrangement enables any bin compartment, except the two end compartments, to be fed forward or reverse to either one of two rod mills, or conversely it enables any rod mill, except the two end mills, to be fed from either one of the two bin compartments to right or left of it, or from both.

Rod Mills Used for Grinding

The grinding section consists of five 5 x 10-ft. Allis-Chalmers rod mills, each in closed circuit with one 54-in. plain submerged Akins classifier. Classifier overflows are delivered to a pump pit below the rod-mill floor, and by a plug-controlled junction box may be sent to any one of three 2-in. Wilfley centrifugal pumps. Wilfley pump discharge lines, together with a feed line to each classifier and a feed line to each flotation section stock tank, are brought to a convenient place in the pump pit and arranged so that, by means of easily adjustable flexible hose connections, the discharge line from any pump can be hooked into the feed line to any classifier or the feed line to any flotation section stock tank. This pump-line "switchboard" arrangement makes for ultra-flexibility in the grinding plant. It allows the plant to grind in single stage or in double stage, or partly in single stage and partly in double stage. Any mill may be used as a first pass mill and any other mill, regardless of position in the plant, may be the second pass mill for that unit. The product of any mill-classifier unit may be sent to any one of the three flotation sections beyond.

Although rod mills were preferred to ball mills, it was felt that some ores might require ball grinding to

achieve requisite fineness. Therefore, two mills—the two most conveniently placed to be used as second pass mills in a two-stage grinding program—were equipped with manholes in case balls should be used. Provision was made to shift the mills and put in larger driving pinions if it were desired to increase the speed of rotation.

New Type of Motor Used

All mills are fitted with Wuest helical driving gears and pinions, and are direct-driven by a motor-speed-reducer unit set alongside the mill. The speed reducers are of special Sykes herringbone gear design with slow and high-speed shafts one above the other in the same vertical plane to conserve mill floor space. The rod mills are driven by 100 hp., 900 r.p.m., Type FTR, Form B, General Electric motors—a type of motor believed to be new in rod-mill driving service. It has the desirable power factor and efficiency characteristics of the ordinary squirrel-cage motor when running under load, yet, due to a double winding, the starting torque is high and the starting current low.

In view of the fact that two, or possibly three, different ores may be handled at one time in the grinding plant, and different flotation reagents used on each ore, it was necessary to keep floor washes from each unit separate. This proved to be no simple matter, as the grinding plant is capable of being operated in several different combinations of grinding units and the floor wash system had to be adaptable to all of these combinations. The thing was done by dividing the floor wash system into three circuits and providing means to divert the floor wash from any grinding unit into any one of the three circuits. Each mill-classifier unit is separated from its neighbor by a ridge in the floor, and the floor area contiguous to that unit is sloped to a screened floor drain fitting situated directly underneath the classifier drain plug. From this fitting a vertical pipe leads into the pump pit below to one compartment of a two-compartment junction box set over a trench containing three launders. The junction box compartment has three plugged holes in its bottom, one hole over each launder. Removal of a plug deposits floor wash into the corresponding launder below. Each of the three launders leads to a floor wash pump sump. Wilfley pumps and sump boxes in the pump pit are drained in a similar manner to the second compartment of the junction box, which is similarly provided with three plugged holes. In this manner the floor wash from any grinding unit and any pumping unit may be drained to one of three floor wash pumps.

Floor wash pumps are the vertical shaft, horizontal runner type, with impeller submerged in a sump 5 ft. below the pump pit floor. The pump shaft is direct-connected by a flexible coupling to a vertical motor. When the level of pulp in the pump sump rises 18 in. above the floor of the sump, the pump motor is automatically started by a float switch. When the sump is clear, and the pump motor thus relieved of load, the motor is automatically stopped by a current-limit relay. All floor wash pumps in the concentrator and thickener plant, eighteen pumps in all, are of this type, automatic in operation.

The three grinding-plant floor wash pump discharge lines are connected through a plug valve arrangement to five risers, which discharge into classifier feed launders, the valve arrangement enabling the operator to throw any pump discharge into any classifier. Floor wash is thus returned to the grinding unit where it originated.

Wilfley pumps, handling grinding-plant product, discharge into 10-ft. diameter by 6-ft. deep stock tanks, one tank to each of three mill sections, set at the same elevation as the table floor, high enough above the flotation machines to discharge into the machines by gravity. Feed to the head of flotation circuits is controlled by a plug valve. A tank of the same size is also provided for the feed to the secondary zinc machines, the two tanks in each section being set adjacent to each other, with the two agitators driven together by one motor. Tanks are agitated by 18-in. Devereux agitators revolving at 120 r.p.m.

Arrangement of the Flotation Department

Equipment in each section of the flotation plant consists of:

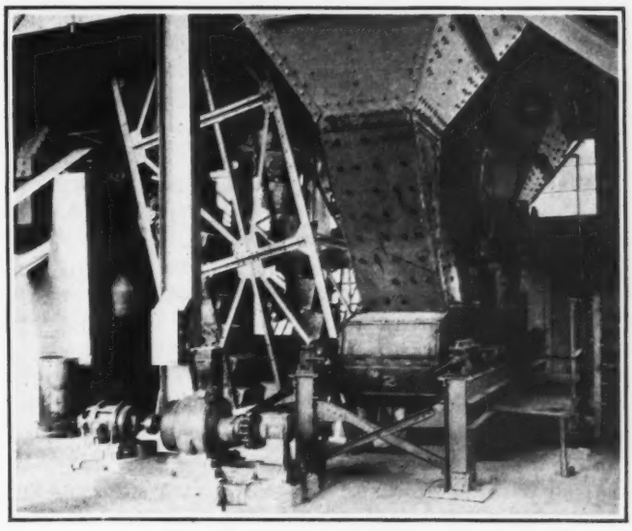
1 12-cell, 24-in. Minerals Separation subaëration machine, which makes a finished lead concentrate and a lead middling, the tailing being fed to

1 10-cell, 24-in. Minerals Separation standard machine, which makes a zinc concentrate and a zinc-iron middling, the tailing being fed (through a 50-ft. Dorr tank) to

1 8-cell, 24-in. Minerals Separation subaëration machine, which makes two zinc-iron middling products, the tailing from this machine being fed to

1 8-cell, 24-in. Minerals Separation subaëration machine, which makes a finished iron concentrate.

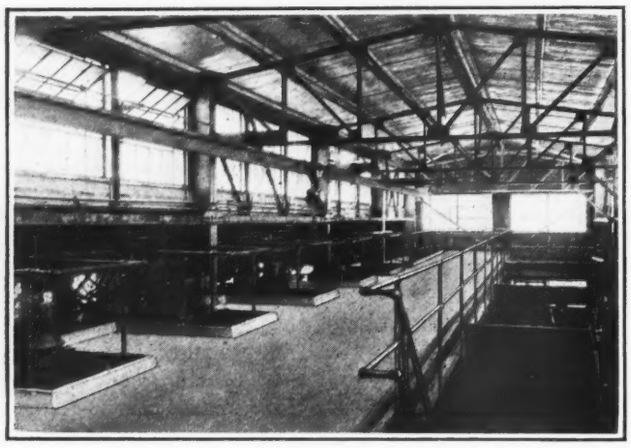
The four flotation machines, constituting one section, are set facing one aisle, the idea being to work one flotation operator on each section, rather than one on lead, one on zinc, and so forth. Grouping flotation machines in this manner also rather facilitates the handling of floor wash—a complex matter at best, as each circuit in each section must be kept separate, owing to reagent conflictions. Flotation-plant floors are sloped, and the lead, zinc and other areas kept separate by concrete curbs, floor wash being gathered in launders hung below the floor and carried to automatic floor wash pumps, which return material to the proper point in the flotation circuit. Circuit launders in con-



Pan feeder and continuous elevator, Midvale crushing plant

stant use are redwood, screwed together, rubber lined, with non-splash moulding screwed on top. Floor wash launders, slop launders from reagent feeder drains, Dorr tank overflow launders, and other launders not subject to severe wear are not lined. Flotation machines are direct-driven by induction motors through Sykes herringbone-gear speed reducers.

The table floor is directly above the upper half of the flotation plant. Each table section consists of four



Reagent mixing floor

Deister Plat-O tables, one table operating on zinc concentrate cut from the first two cells of the primary zinc flotation machines, and three tables operating on tailing from the pyrite machine. In section No. 3 the last two cells of the secondary zinc flotation machine are arranged so that the froth overflow from them may be sent to one of the iron tables, where a zinc concentrate may be made—this to take care of ores high in zinc. Tables are individually driven by back-geared, 1½-hp. motors, direct-connected to head motions. The four tables constituting one section are set together and adjacent to reagent feeders operating on that section, with convenient stairways leading to the flotation floor below. All equipment under the supervision of one flotation operator is thus grouped together.

Tank and Pumping Equipment

The dewatering plant is housed in a separate building 82 ft. south of the concentrator building and connected thereto by a covered gallery. Dewatering equipment consists of six 50 x 12-ft. Dorr tanks, one tank for each of the three concentrate products and one tank in each of the three zinc circuits. The latter three tanks serve not only as thickening tanks, to bring the zinc circuit pulp back to proper density for flotation, but also as conditioning tanks to give the pulp ample time exposure to copper sulphate reagent. All tanks are built of wood staves 9 ft. 6 in. long, set on concrete bottoms which slope to match the pitch of the Dorr rakes. Wood staves rest on a concrete shelf projecting from the tank foundation wall and are drawn against the concrete bottom, a ½ x 3-in. wood filler strip being laid between the two. The opening between the staves and the concrete bottom, above the filler strip, was calked with oakum after the tanks were assembled and plumbed, and Johns-Mansville expansion-joint filler was poured in hot on top of the oakum to assure a watertight joint.

Tank mechanisms are supported by the roof structure of the dewatering building. Drive gears and shafthead mechanisms are housed in dormers, from which stairways lead to a walkway running the full length of building above the top of tanks.

Tank underflow piping is hung in tunnels below the tank building floor. Underflow from concentrate tanks is controlled by 4-in. Dorrco diaphragm pumps, duplex pumps being used on the zinc and iron tanks and a simplex pump on the lead. Underflow from zinc conditioning tanks is simply drawn through a spigot. All tank underflow products are pumped back to the mill by 2-in. Wilfley pumps, zinc-conditioning tank underflows going to surge tanks at the head of secondary zinc machines and concentrate products to the filter plant.

Disk Filters Used

Filter-plant equipment is housed in the concentrator building. A six-leaf 6-ft. diameter American filter operates on iron concentrate and one five-leaf 6-ft. diameter American filter on each of the lead and zinc products. Each filter sits directly over a 125-ton storage bin, which discharges through manually operated slide gates into railroad cars below. The bin installation was made necessary by the fact that the company does not do its own switching; hence concentrate cars cannot always be had when desired. However, when cars are available bin gates can be opened wide and filter cake dropped through the bin into cars—slide gates being arranged so that when opened to their maximum extent a clear opening 14 ft. long (the full length of bin) and 2 ft. wide exists in the bottom of the bin.

The vacuum on the filters is maintained by a barometric leg. Outflowing filtrate from the barometric wells joins the overflow from corresponding concentrate dewatering tanks and flows underground through 4-in. tile pipe to slime ponds. The slime ponds are intended to act as emergency traps for any concentrate which may accidentally escape from the plant.

A vacuum pump, two blowers for flotation air, a low-pressure compressor for filter air, and a 100-lb. compressor, which furnishes air for general purposes about the plant, are installed on the ground floor of the mill adjacent to the filter plant. The barometric wells are also in this bay.

Reagent Handling a Complex Matter

Owing to the large quantity and variety of reagents used in the plant, reagent handling arrangements are more complex than usual. For reagent oils, two 14,000-gal. steam-heated storage tanks are placed below the coarse-ore trestle, so that tank cars may be discharged by gravity. A 1-in. duplex Blackmer rotary pump delivers reagent oils to two 250-gal. tanks on the reagent mixing floor at the top of the mill. A piping system from the 250-gal. tanks provides facilities for making three oil mixtures in three 1,000-gal. tanks placed below the reagent mixing floor on the reagent storage balcony.

Solid reagents are stored in a two-story wing of the concentrator building, built for that purpose. A 2,500-lb. capacity platform passenger elevator connects this storeroom with the reagent mixing floor, on which reagents are mixed in specially designed agitation tanks. Pipe lines connect the agitation tanks with reagent storage tanks on a balcony below. From the reagent

storage tanks and oil-mixture tanks reagents flow by gravity to reagent feeder batteries, of which there are fourteen of four cells each, nine batteries on the table floor to serve flotation circuits and five above the rod-mill floor to supply the rod mills.

How Reagent Feed Is Adjusted

Reagent feeders are tipping cups, which rise and fall in guides, the discharge lip of cup being thrust over a launder at the top of its stroke by a dump track arrangement somewhat similar to the familiar one used with mine skips. The angle of tip of cup, and hence the amount of reagent discharged from the cup, is controlled by an adjustable reach rod. The speed of travel of the cup may also be altered and the rate of feed further increased or decreased by a friction disk drive. This particular feeder was selected because of its adaptability to various kinds of reagents and its wide range of feed adjustments. Reagent feeders are mounted on a slightly raised area of floor bounded by concrete curbs and floored over by wooden grid walkways. All slop from the feeders, as well as floor wash from reagent mixing and storage floors, drains through floor traps into a slop launder and passes from the mill via the tailing launder.

The capacity for which the concentrating plant was designed is 600 tons in twenty-four hours. The plant is divided into three sections, each of which has a capacity of 200 tons.

Power at 44,000 volts is delivered by the Utah Power & Light Co. to the primary taps of three 833-kva. transformers. From the secondary taps of the transformers 440-volt lines lead through oil switches to a switch room on the ground floor of the sample-mill building, in which are assembled all the switches in the plant. The switch room is closed off by a wire-mesh partition from the building proper and is accessible only to mill electricians. All controls in the plant are start-and-stop push-button stations, installed at desirable points for operating.

The concentrator building is heated by a 225 hp. Sterling boiler removed from one of the company's unused power plants and remodeled for this service. Radiators are "Venturafin" units, mounted on 14-gage iron ducts.

The mill water supply is pumped from the Jordan River Canal by two 5-in., 750-gal.-per-minute Fairbanks-Morse, single-stage centrifugal pumps, direct-connected to 35-hp., 1,800 r.p.m. motors. One pump takes care of all mill-water requirements, the other being held as a spare. A steady-head tank of 27,000 gal. capacity, housed in a tower 88 ft. above the ground, supplies the mill pipe lines.

New Type of Walls Attracts Notice

All buildings are of structural steel, on reinforced-concrete foundations, with reinforced-concrete floors throughout. The roofs of the crushing plant, conveyor galleries, and concentrator building are of 2-in. tongue-and-grooved fir sheathing, covered with 150-lb. Johns-Mansville built-up asbestos roofing. About half the wall area of the buildings is glass. Window sash are Fenestra steel, 14 x 20-in. lights, glazed with double-strength plain glass. The five clerestories in the concentrator building are fitted with continuous sidewall sash. All buildings are quite light, and the light effect is enhanced by glossy, hard-surfaced, light battleship-gray paint.

The crushing plant, conveyor galleries, and concentrator are covered with a thin wall of gunite. The manner of applying gunite caused much comment by visitors during the progress of construction. This wall is believed to be the first of its kind ever built. National Steel Fabric Co.'s mesh No. "P214"—a mesh of 14-gage wires spaced 2 in. center to center in both directions with special paper backing—was wired to the building girts. Three-quarters of an inch of gunite was then shot on the outside of the wall with the paper as a backing. After this gunite coat had set, half an inch of gunite was shot on the inside, the latter coat being keyed on partly by exposed wires and partly by "buttons" of gunite formed by the exterior coat shooting through holes in the paper at mesh wire intersections. The total thickness of wall runs from 1¼ to 1⅝ in. The wall has good insulating qualities, is fireproof, very strong, and, it is hoped, is repair-proof. Considering these desirable characteristics, the covering was put on at a cost favorably comparable with the more usually used types of mill-building covering.

Possible Uses of Californian Black Sand

There are extensive stretches along the coast of California where the heavier constituents of the beach sands have been concentrated by wave action into deposits of so-called "black sand," says a recent bulletin of the California State Mining Bureau. The composition of this heavy concentrate varies somewhat with the locality. In general, the following commercial minerals are present in greater or less amount: magnetite, gold, ilmenite (oxide of iron and titanium), garnet, zircon, hematite, chromite, and the platinum group metals. Could each of these minerals be readily and completely separated from the others and from the olivine, quartz, and other worthless constituents, they would be readily marketable. Gold and platinum are found in relatively minute amounts only, but on account of their high value, practically all past efforts to work these sands have been confined to the recovery of these metals.

Besides the uncertain profitable production of gold and platinum from this source, the use of black sand in the manufacture of artificial iron castings, where great strength is not required, has been suggested. Some experimental work has been carried on to determine the practicability of the use of these sands for this purpose, including the making of sash weights by molding or briquetting the material into the desired form with oxy-chloride (magnesite) cement, portland cement, or other binder. Black sand may also be utilized in concrete mixes, where a concentrated weight is wanted, as in concrete balance-weights used on bascule-type bridges and similar structures.

By subjecting the magnetite in black sand to an oxidizing roast, it may be changed to the ferric state, producing a red oxide (Fe_2O_3), which forms, when finely ground, a mineral pigment suitable for the manufacture of paint. The pigment so made is said to be superior to ground hematite or the natural soft red oxide. Magnetite in black sand is also used as an ore of iron to some extent. This magnetite usually contains from 5 to 10 per cent of titanium.

Solution of Tin Minerals Studied

By J. W. Gruner and S. C. Lin
University of Minnesota, Minneapolis, Minn.

THE RECENT PAPER "Geologic Features of Bolivia's Tin-bearing Veins," by F. R. Koeberlin (*Engineering and Mining Journal-Press, Vol.* 121, p. 636, 1926), describes some deposits of cassiterite in which, according to field evidence, it appears that much secondary cassiterite was deposited under conditions resembling those found in the zone of secondary sulphide enrichment. The cassiterite occurs in such deposits with marcasite, franckeite ($Pb_5Sn_2Sb_2S_{12}$), sphalerite, and greenockite. Mr. Koeberlin himself enumerates a number of objections which might be raised against the probability of solution of cassiterite in the zone of oxidation and its reprecipitation at some lower level. Primary stannite $(Cu_2FeSn)S_4$ occurs in only small quantities below the enriched ores. Therefore, these inadequate amounts of stannite cannot be called upon to explain the enrichment, according to Mr. Koeberlin. Copper, probably mostly as sulphides, seems to be present in larger quantities in the deposits showing enrichment than in veins where no secondary cassiterite is found. Unfortunately, it is not stated whether the "secondary" cassiterite is found in the form of wood-tin or not. Pyrite is an abundant mineral in the deposits.

Many deposits of wood-tin, probably mostly secondary, have been described by Emmons,[1] who also treats of the enrichment of tin deposits. Investigators seem to agree that cassiterite dissolves with the greatest difficulty, if at all, in cold solutions. Stannite, however, may go into solution slowly, as do other sulphides, and supply some tin in the form of wood-tin to lower levels. To prove this point the junior author in 1923 made two sets of experiments.

Specimens of stannite and cassiterite were pulverized to pass 100 mesh. The stannite was from the East Pool mine, in Cornwall, England, and contained as impurities pyrite, chalcopyrite, wolframite, and traces of arsenopyrite. The cassiterite was from Ehrenfriedersdorf, Saxony, having apatite and fluorite for gangue. Five-gram portions of cassiterite were put into 250-c.c. pyrex flasks with the following solutions:

Table I—Solubility of Stannite in Dilute Acid and Carbonate Solutions After Two Months

Solution	Tin Dissolved, in Parts per Million
50 c.c. N/20 H_2SO_4	5
25 c.c. N/20 H_2SO_4 + 25 c.c. N/20 $Fe_2(SO_4)_3$*	8
25 c.c. N/20 H_2SO_4 + c.c. N/20 $FeSO_4$†	2
50 c.c. N/20 HCl	20
25 c.c. N/20 HCl + 25 c.c. N/20 H_2SO_4	15
25 c.c. N/20 HCl + 25 c.c. N/20 $FE_2(SO_4)_3$*	2
25 c.c. N/20 HCl + 25 c.c. N/20 $FeSO_4$†	Faint Trace
50 c.c. N/20 Na_2CO_3	None

*$Fe_2(SO_4)_3$ solution was made by dissolving 2.5 grams of $Fe_2(SO_4)_3$ in one liter of N/20 H_2SO_4.
†$FeSO_4$ solution was made by dissolving 3.8 grams of $FeSO_4$ in one liter of N/20 H_2SO_4.

Five-gram portions of stannite were treated with the same solutions as shown in Table I. Since tin deposits are usually accompanied by minerals containing fluorine, a pinch of powered fluorite was added to each flask. It was thought that fluoride ions, which might possibly form in the acids, could influence the solubility of tin minerals. The flasks were corked and shaken once a day. After two months, 20 c.c. of solution were taken from each flask and tested for tin. Standard methods were followed for separating tin from the other metals. Metallic zinc was then added to the hot hydrochloric acid solution to reduce any tin present. Ammonium molybdate was added immediately after all zinc had been dissolved. A stannous chloride solution is colored blue when ammonium molybdate is added. This test will detect one part of tin in a million and a half of solution.[2] The amount of tin in the solution was estimated by colorimetric comparison with a standard tin solution. On account of the minute amount of tin in solution, it is highly probable that any other quantitative determination of the metal would not have given more accurate results. Tin was found to be present in all the solutions with stannite, except that of sodium carbonate. No tin was detected in the solution containing cassiterite. Table I shows the results obtained in the stannite solutions.

The experiments show that the solution of stannite and transportation of tin in ground waters is not only possible but probable. The hydrochloric acid solution seems to be most effective in attacking the stannite. As sulphates of tin hydrolize more easily than chlorides, a sulphuric-acid solution would be expected to carry less tin. A combination of HCl and sulphates of iron is surprisingly ineffective as a solvent.

The insolubility of cassiterite seems to be even more marked than had been indicated by Emmons. Only a very powerful reducing agent like nascent hydrogen will cause tin oxide to dissolve in an acid solution. Under oxidizing conditions like those existing near the earth's surface in the zone of oxidation such powerful reducing agents are unknown. But, if one did assume that tin went into solution by reduction of cassiterite near the surface, then it would be impossible to explain its reprecipitation as cassiterite at a deeper level under reducing conditions.

In the case of stannite, however, acids will attack the mineral and dissolve it. Precipitation of the dissolved tin probably comes about by hydrolysis of the stannic salts to $Sn(OH)_4$. It is quite possible that stannic salts in very small concentrations can be transported by descending ground waters before being converted to the colloidal hydroxides. Transportation as colloids is also probable for short distances. From the colloidal $Sn(OH)_4$, wood-tin forms by dehydration. For the movement of tin as sulpho-stannate, alkaline conditions and alkali-sulphides would be necessary.

It appears, then, that laboratory experiments are against the probability of any solution of cassiterite either in the oxidizing or reducing zone, provided the solutions are cold. Stannite and other sulphides and sulpho-salts of tin may go into solution slowly. Reprecipitation would probably be as wood-tin.

The facts as stated for some Bolivian tin deposits cannot be explained on the basis of chemical behavior of cassiterite in the oxidizing zone. As copper minerals seem to be almost universally present in the enriched deposits at somewhat higher levels than the cassiterite zone, and franckeite is associated with the cassiterite, one unfamiliar with the field evidence would conclude that the "secondary" cassiterite was derived from stannite and similar tin minerals. Though stannite seems to be present in inadequate amounts in the primary ore, which is open to inspection, to account for the enrichment of tin is it not possible that stannite was much more plentiful in the portions of the deposits now oxidized and eroded?

[1] Emmons, W. H. "The Enrichment of Ore Deposits," U. S Geological Survey, Bulletin 625, pp. 398-402, 1917.

[2] Lengstaff, *Chem. News*, Vol. 80, p. 282, 1899. Rogers, *Jour. Chem. Soc.*, Vol. 22, p. 220, 1900.

Diamond Mining in 1925

Increased Yield Amounted to Fourteen per Cent—Belgian Congo Second in Production—United States Largest Purchaser—Many New Companies Formed

By Sydney H. Ball
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THAT DIAMOND MINING was prosperous in 1925 is indicated by a satisfactory increase in dividends paid by various operating companies, by the sale of an increased quantity of rough diamonds at rising prices, and by the avidity with which South African promoters floated new diamond issues. The approximate production for 1925 follows:

Diamond Production in 1925

	Pipe Carats	Alluvial Carats
South Africa	2,190,871	239,257
Belgian Congo	.....	885,000
South West African Protectorate (estimated)	.....	600,000
British Guiana (exports)	.....	188,208
Angola	.....	125,000
Gold Coast (estimated)	.....	135,000
Brazil (estimated)	.....	50,000
Miscellaneous	500	6,000
Totals	2,191,371	2,228,465
Grand total, carats		4,419,836

This is a 14 per cent increase in weight over 1924, notwithstanding a small decrease in the South African production, although its value increased slightly. By weight and value, the pipe mines accounted for respectively 49.9 per cent and 48 per cent of the total; and the alluvial mines respectively 50.1 and 52 per cent. It may be mentioned in passing that twenty-four years ago the pipe mines were responsible for about 95 per cent of the world's production. The more marked changes in comparison with 1924 were the doubling of the Gold Coast production and the continued increase of that of the Central African fields (Belgian Congo and Angola).

The market for rough diamonds was steady throughout the year, and, most of the time, strong and active. Prices rose somewhat, and sales exceeded those of 1924. The producers sold rough goods to the value of over $60,000,000, South African sales alone exceeding production by $2,500,000. Fancy cut stones (marquises, pear-shaped diamonds, and emerald-cuts) of from 2 to 5 carats were in demand throughout the year and at times were hard to get. Small cut stones were on the average less sought after, although at times the demand for these stones was strong.

Stones of Russian origin were not a factor in the 1925 market, and, though the Soviet government early in 1926 sold some stones, many of these will not appear on the market until recut.

The United States imported slightly more diamonds in 1925 than in 1924, as the following figures indicate:

Diamond Imports into United States

	1924		1925	
	Carats	Dollars	Carats	Dollars
Rough, uncut	213,406	11,660,802	171,842	9,492,326
Cut, but not set	502,144	47,268,188	513,783	49,620,666
Imported from—				
Belgium	267,487	24,007,491	239,290	21,336,808
France	5,430	914,208	8,314	1,497,219
Netherlands	216,048	21,216,569	252,202	25,264,131
United Kingdom	9,354	764,279	10,865	1,173,456
Other countries	3,825	365,641	3,112	349,052
Total imports	.....	$58,928,990	.....	$59,112,992

The United States continues to be by far the best customer of the diamond trade. It will be noted that Amsterdam supplanted Antwerp as the premier source of our cut goods. Most of the uncut stones came from the London Diamond Syndicate, and the figures suggest that American cutters did not enjoy a prosperous year. The jewelers' stocks of diamonds on Jan. 1, 1926, were not large, and this and the prosperous condition of the country augur for increased imports in 1926. England is still too highly taxed to buy its normal quantity of diamonds. In France, the luxury sales tax, the fluctuation of the franc, and the proposed tax on unemployed capital, notably jewelry, reduced the sales to the French, although Parisian gem merchants enjoyed a large tourist trade. Japanese purchases were small, owing to a new luxury tax and also to the low value of the yen during much of the year.

European diamond cutters suffered little unemployment. They complain, however, that the spread between what they had to pay for the rough and what they received for the cut product was distressingly small.

New Diamond Syndicate Formed

On Dec. 31, 1924, the producers' agreements with the Diamond Syndicate expired. After long negotiations a New Diamond Syndicate was formed, the principal members being Sir Ernest Oppenheimer and S. B. Joel. Its first sales were made on Oct. 27, 1925. Its agreement with the producers runs until Dec. 31, 1930. The machinery by which sales have been made in the past is not to be changed; the price to be paid producers is to be determined semiannually, based on the results of sales of the preceding six months; the syndicate accepts all (if any) losses and receives all profits up to a certain figure, beyond which the profits are divided between the producers and the syndicate.

The new syndicate controls directly or indirectly the sale of at least 85 per cent of the world's production; in other words, a larger proportion than the old syndicate controlled in recent years. The formation of the syndicate was greeted with approbation by the trade, and since that event the rough market has been stronger, prices of rough stones have tended to increase, and the shares of most diamond companies have appreciated in market value.

South African Production Decreases

Diamond production of South Africa in 1925 was slightly less than that of 1924, the pipe mines increasing their production by 13,500 carats and the alluvial mines producing 48,300 carats less. This is the lowest alluvial production for three years. The De Beers Consolidated Mines, Ltd., for the year ended June 30, 1925, increased its dividend rate, partly through the sale of some of its securities, as its diamond sales were slightly less than in the preceding fiscal year. Of the 4,215,172 loads treated, 2,818,096 loads were mined and the rest came from stocks. The Premier Diamond Mining Co., Ltd., in the year ended Oct. 31, 1925, sold diamonds to the value of £1,271,003, a considerably greater quantity

than in the previous twelve months. It washed 3,752,737 loads and produced 733,068 carats, or a 6 per cent increase over the record for the preceding year. The reserves above the 460-ft. level are 28,000,000 loads. The New Jagersfontein Mining & Exploration Co. for the year ended March 31, 1925, treated 1,403,028 loads for a recovery of 153,506 carats. Koffyfontein Mines, Ltd., at its annual meeting in December, 1925, reported a profit of £85,163. The West End Diamonds, Ltd., one of the smaller companies, showed an operating profit for the year ended June 30, 1925, of about £65,663. The New Vaal River Diamond & Exploration Co., one of the few companies operating river deposits, had a profitable year, producing, in 1925, 10,550 carats, worth £87,163, equivelent to £8 5s. per carat.

As is usual when diamond mining is prosperous, a number of new companies were floated: some to refinance formerly unsuccessful companies and others to develop new discoveries. In the past the mortality among such companies has been great. At least three companies were floated to treat alluvial deposits and six to work pipe deposits. Most of the latter are situated in the general vicinity of Pretoria, Transvaal, and, in part at least, are a side issue of the platinum boom.

Alluvial Mining Older

Alluvial digging in South Africa employs about 7,000 whites and 25,000 blacks, and as an industry antedates pipe mining. That it is an asset to the Union is, however, open to question, as the average digger lives in abject poverty amid unsanitary surroundings. It is only the exceptionally lucky or capable digger that makes a decent living. The land owner may, however, out of his royalties and rents, receive a handsome income. Certainly the policy of the government in continuing to proclaim new alluvial areas is short-sighted, but the diggings bring in a certain amount in taxes and the South African politician knows that the alluvial mines have three or four votes to one possessed by the pipe mines. The government in the past has consistently favored the alluvial miner, and, in consequence, the threat in the summer of 1925 to extend the Color Bar Bill to the alluvial mines was surprising, as few diggings could survive its enforcement.

The South African Government received in 1924-25 as revenue from the diamond industry £1,358,000, and from 1910 to 1924, not a prosperous period in South African diamond mining, nearly £13,750,000. It seems to be the aim of politicians at every turn to increase taxation, notwithstanding the opinion of those closely in touch with the industry that further increases may jeopardize its life. The government continues to interfere with the business of the companies, and in 1924 the directors of the Consolidated Diamond Mines of Southwest Africa claimed that the Union Government concluded "an inferior sales contract" for the company's product, resulting in a loss of about $800,000 to the company.

In 1925 the South African legislative body passed the Diamond Control Bill. It was summarized at the time by the *African World* as follows:

"The Bill enables the Government to assume control of the diamond trade, fixing quotas of production, laying down minimum prices, and appointing a Diamond Board which will buy and sell diamonds or act as a selling agent. The board will have power to compel any producer to supply it, and may then sell on producer's behalf at a reasonable price, less commission. The government may also prohibit the export of diamonds except with the board's consent. The board is to consist of three members, no one of whom shall hold, directly or indirectly, any share or interest in any undertaking for winning or dealing in diamonds. The powers of the board may be extended to the diamond-cutting industry. The Minister of Finance may advance sums to the board. While alluvial diggers are exempt from the provisions of the bill they may use the board for the disposal of their diamonds."

The bill of course is only an enabling act, but appears to be an unpardonable instance of government interference with private rights and interests. That a government would seriously consider taking a highly involved industry like diamond production and marketing out of the hands of men who have given the best years of their life to its study seems unbelievable.

Agitation to establish an industry to cut diamonds in the Union was particularly active in 1925, and that it may be tried out is suggested by the fact that Kimberley, Durban, and Capetown presented proof that each is the ideal site for the industry. South Africa has not the proper labor for the industry, and the local high cost of living would not permit the cutting of small stones. The establishment of the industry would without doubt result in an increase in the South African export duty on rough goods, and might result in high tariffs against South African cut goods in other countries and in an attempt by European cutters to increase diamond production outside of the Union. The post-war diamond-cutting experiment at Brighton, England, should be a danger signal to South Africa.

The production of the alluvial mines of the Southwest African Protectorate increased in 1925. The principal producer, the Consolidated Diamond Mines of Southwest Africa, showed an operating profit of £502,234 and a net profit of £263,352. It sold during the year 601,874.75 carats for £1,755,249 (say $13.50 per carat). On Dec. 31, 1925, it paid its initial dividend.

Belgian Congo Holds Second Place as Producer

The production of the Belgian Congo and Angola companies operating the Central African fields is given on page 925. The Belgian Congo holds second place in the world as a diamond producer, and further increases in the production are to be expected.

A number of diamond discoveries were made during 1925 in outlying parts of both the Belgian Congo and of Angola, but none of these are as yet known to be of commercial value. Mr. Robert Williams recently reported that the Tanganyika company's subsidiary, the Kundulungu Exploitation Co., is to resume development of some of its kimberlite pipes in the southeast part of the Belgian Congo.

Gold Coast an Important Producer

The growing importance of the Gold Coast diamond field is indicated by the production figures. From 1919 to July 31, 1924, 64,732 carats were produced, worth £79,606, or $5.78 per carat; from Aug. 1, 1924, to June 30, 1925, 50,268 carats were produced, worth £74,341, or $7.16 per carat. Of the latter amount 37,000 carats were produced in the first half of 1925, the year's production being estimated at about 135,000 carats. The 1925 exports were valued at £184,000. The stones are on the average small, the largest stone found up to midsummer 1925 weighing 9 carats. For the year

ended March 30, 1925, the gravel treated averaged 1.59 carats per cubic yard. The principal company is the Consolidated African Selection Trust, which in December, 1925, reported that it had fully and partly developed 6,000,000 carats. Its plant began operating in June, 1925, and the production rate for the last half of 1925 was about 16,000 carats per month. The plant is later to be increased. The West African Diamond Syndicate reported in December, 1925, a reserve of 1,000,000 carats. Its plant, with an initial capacity of 800 yards per month, began washing on Nov. 4, 1925. Other units will be added in the near future.

Diamonds Discovered in Tanganyika in 1910

As early as 1910 an occasional diamond had been found in Tanganyika Territory southeast of Lake Victoria, Central Africa. In August, 1925, the Tanganyika Diamonds, Ltd., was registered in South Africa with a capital of £75,000 in 5s. shares. The company has been the most spectacular of those floated in 1925, its shares fluctuating violently, and its deposit being the subject of acrid discussion as to whether it is or is not a pipe. In December, 1925, the Anglo-American Corporation, after examination by its own engineers, took an option to develop the property. Late in the year a plant with a capacity of thirty-five loads per hour was arriving. The country rock is granite, and the pipe, which is said to have been found, is said to be large. In preliminary development 1,563 loads yielded 370.3 carats, or an average of 23.7 carats per 100 loads. That the Anglo-American has taken an interest in the property speaks well for it; on the other hand, the location of the property means high operating costs, and the grade of the surface material is markedly below that of the De Beers, Kimberley, and Premier mines in their early days.

The British Guiana production in 1924 consisted of 1,055,425 stones, weighing 185,585 carats, with an export value of £858,322. This is equivalent to 6.2 stones per carat and a per carat value of about $22.20. The largest stone weighed 18⅛ carats. The exports for 1925 were 188,208 carats, valued at $4,057,285. ($21.56 per carat.)

A few diamonds were probably produced in eastern Venezuela, a western extension of the British Guiana field. The Dutch Government reports important diamond discoveries in West Borneo.

New finds in Goyaz and Matto Grosso drew some miners from the older Brazilian fields last year, but their exploitation was, according to well-founded information, interfered with by political conditions. The occurrence of a few diamonds in the State of Maranhao is reported. Bahia is considering changes in its mining laws to induce companies with large capital to interest themselves in diamond mining.

In industrial fields, the demand for carbonados, "flats" for wire-drawing, and round stones for emery-wheel truing was good; that for crushing borts weakened. The production of carbonado in Bahia decreased, owing to the departure of some of the miners for the Goyaz and Matto Grosso fields and to local political disturbances. The quality of the carbonados also fell off. In the first ten months of 1925 Bahia exported to the United States 15,314 carats of carbonados, worth $854,508. The average price, $56 per carat, is $19 more than that of 1924. The 1925 carbonado production was about 22,000 carats.

The increased prices for carbonados somewhat restricted their use, and Continental factories in particular, where possible, replaced them with bort. Imports of industrial stones into the United States increased from 1924 to 1925, as shown in the following table:

	1924		1925	
	Carats	Dollars	Carats	Dollars
Diamond dust and bort	.....	259,482	.....	760,476
Glaziers', engravers' and miners' diamonds	32,463	1,116,862	46,556	1,976,640

A Pack Train in Mexico

Drilling and Blasting in United Verde's Open-Pit Mine*

How Ground Is Prepared for Steam Shovels by Primary and Secondary Operations—Loading Horizontal Holes Rapidly With Powder by Machine—Breaking Rock on a Large Scale by Coyote Methods

By C. E. Mills
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OPEN-PIT MINING as practiced by the United Verde Copper Co., at Jerome, Ariz., is a combination of shovel and mill-hole methods for the recovery of orebodies lying between the surface and the 500 level. Mill-hole work has been carried on for possibly fifteen years in the oxide and schist zone at the south end of the present pit. The greater portion of the ore, however, was in the fire zone, and steam-shovel operations were started early in 1919 for the purpose of uncovering this fire area. Pit limits on the 160 level are approximately 1,000 ft. in a north-south direction and 500 ft. in an east-west direction. The ore occurs in the form of massive sulphide, schist, oxide, quartz, and porphyry. The greater portion of the stripping is in a hard, blocky diorite, locally known as United Verde diorite.

Table I shows roughly the yardage removed to date and that remaining to complete the major shovel operations.

Table I—Yardage Removed to Date in United Verde's Open-Pit Mine

	Yardage Removed	Yardage Remaining	Total Yardage
Steam Shovel Yardage			
Ore	808,000	96,000	904,000
Waste	5,780,000	729,000	6,509,000
Total	6,588,000	825,000	7,413,000
Mill-Hole Yardage			
Ore	83,000	2,069,000	2,152,00
Waste	54,000	1,022,000	1,076,000
Total	137,000	3,091,000	3,228,000
Grand total	6,725,000	3,916,000	10,641,000

The shovel pit as originally planned had eight major levels. The bottom level had a 110-ft. bank, and the remaining banks averaged 50 ft. in height. The greater portion of the stripping was on the west side of the pit in hard diorite. Stripping operations above the 160 level are served by a series of switchbacks on a 3 per cent grade. Shovel equipment consists of one Marion 300-ton, 8-cu.yd. steam shovel and two Osgood Model 120 railroad-type 4-cu.yd. steam shovels mounted on caterpillars. The muck is removed to the waste dumps by 25-cu.yd. Western Wheeled Scraper dump cars.

Below the 160 level, a combination of mill-hole and shovel methods will be used in operation. Equipment for this work consists of two Bucyrus Model 50-B 1¾-cu.yd. electric shovels. Both waste and ore are handled by motor trucks to a raise leading to ore bins on the 1,000-ft. main haulage level of the mine.

In preparing the ground for shovel loading, the drilling and blasting may be divided into primary and secondary operations. Primary blasting is accomplished by churn-drill holes, vertical Leyner holes, jackhammer toe holes, and coyote methods. Secondary blasting consists of plugging and "dobeying" boulders and slabs to a size sufficiently small to be handled by the shovels. Wide variations in the character of the rock made it impossible to formulate any set rules for drilling and blasting which will apply to all cases. The general methods used will be described in more detail.

*"Drilling and Blasting Underground at United Verde's Mine," by C. E. Mills, appeared in last week's issue.

Use of Churn Drills Limited Today

When shovel operations were started, churn-drill blasting was used in removing the entire 110-ft. initial cut and in establishing the various benches or levels. The main advantage of the churn drill over machine drilling is that the depth of hole is not limited as in the case of the Leyner holes. This permits higher benches to be shot and makes possible wider cuts.

No. 5 Keystone well drills, using 6- and 8-in. bits and 16-ft. stems, are used. The rate of drilling varies widely, depending both on character of ground and on the proficiency of the drill crew. Drilling speeds for the various classifications of ground are as follows: Oxide and oxidized quartz, 20 to 30 ft. per shift; schist and soft diorite, 10 to 15 ft.; fresh diorite and jasper, 3 to 5 ft. per shift. The average footage drilled per man-shift is 2.5 ft. in moderate ground and 0.75 ft. in hard diorite. This includes delays and time taken in moving. The drilling crew consists of a runner, one fireman and a coal boy.

Because the major portion of the stripping is now in hard diorite, the use of the churn drills has become limited. They are now used chiefly for sloping high banks, drilling and shooting hot ground, and in altered diorite or oxidized quartz where the cost of drilling is not excessive.

Spacing of Churn-Drill Holes Depends on Ground and Height of Bank

The location, spacing, and depth of churn drill holes depends entirely on the height of bank and character of material. For medium ground, the allowable burden should never be less than 16 ft. for 20-ft. banks and 50 ft. for 100-ft. banks. Table II gives common practice at the United Verde:

Table II—Spacing and Depth of Churn-Drill Holes

Height of Bank, Feet	Burden on Hole, Feet	Spacing of Holes, Feet
50	28 to 36	32 to 44
110	36 to 44	55 to 95
150	40 to 50	100 to 135

The sub-grade or depth of bottom of hole below the floor of cut is usually 10 per cent of the height of bank being drilled.

In hard ground it is usually necessary to spring the hole three times to form a chamber of sufficient size to take the required charge of powder. In medium ground, twice is sufficient. The powder charge will vary from 600 lb. in 50-ft. holes to 8,000 lb. in 150-ft. holes. In certain instances as high as 10,000 lb. of explosives have been used in one hole. The holes are sprung with 50 per cent gelatin and electric detonators. The amount of powder used in springing will run as follows:

First springing— 1 to 1½ per cent of total powder charge
Second springing— 2½ to 3½ per cent of total powder charge
Third springing— 7 to 10 per cent of total powder charge

Loading Churn-Drill Holes

Apache No. 1 Quarry Special bag powder is used in all dry holes, and 35 per cent gelatin stick powder in wet holes. In the latter case, the sticks are cut into 2-in. lengths before dropping in the hole.

The primer is made up by placing one No. 8 electric detonator in one of several sticks of powder, which are tied together. The lead wires are attached to No. 14 insulated wire and lowered to the bottom of the hole. A string of Cordeau is next wrapped around six or eight sticks of powder and also placed in the hole. A portion of the powder charge is next loaded and another primer similar to the first one, already described, is placed near the top of the charge. The remainder of the charge is then placed and the hole tamped with sand or fine dirt. The Cordeau is then capped with a No. 8 detonator, all three lead wires are connected in parallel, and the hole is shot, using 440 volts a.c. current. If more than one hole is shot at a time, all lead wires are connected in parallel and shot in the same manner.

The powder is loaded into the hole by means of an inclined trough, which allows all loaders excepting the man handling the tamping stick to work at a distance from the collar of the hole. When a shattering action is desired, the hole is loaded up into the barrel; otherwise, the charge is confined to the chamber at the bottom. Jackhammer toe holes are occasionally used to relieve the toe of the bank in case the burden is excessive.

Hole Is Cooled With Water When Hot

In some instances, it has been necessary to shoot holes where the rock temperature is as high as 240 deg. F. The hole is cooled by running cold water into it until tests with a thermometer show that the length of time required to heat up will allow sufficient time for loading and firing. The hole is then sprung, cooled again, and loaded with gelatin powder.

The average cost of drilling churn-drill holes is given in Table III.

Table III—Cost of Drilling Churn-Drill Holes

Churn-Item	Cost per Foot	Cost per Shift
Labor	$2.54	$13.68
Fuel	1.15	6.19
Supplies	0.89	4.77
Repairs	1.37	7.50
Total	$5.95	$32.14

Machine Drilling and Blasting

The Sullivan DP 33 machine is used for all plugging and toe holes. All jackhammers are equipped with special air connection which allows full air pressure to be blown through hollow steel. The Ingersoll-Rand

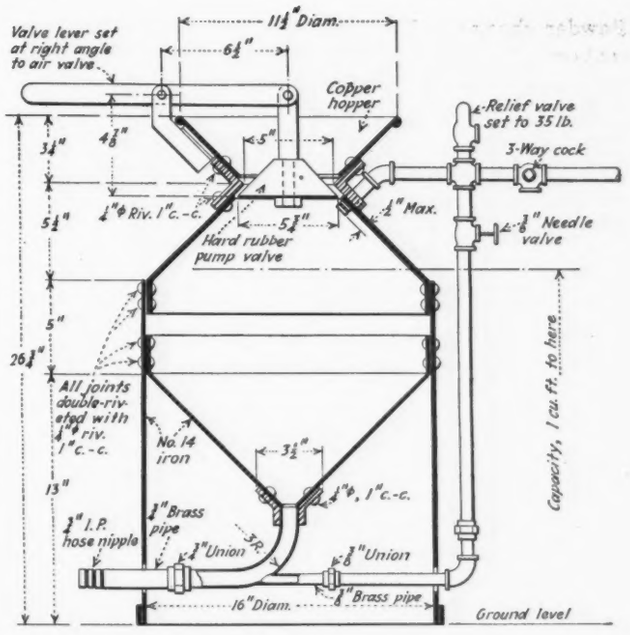


Fig. 1—Powder loading gun for horizontal holes, used by United Verde Copper Co.

248 machine is provided with handles and used for drilling vertical holes up to 27 ft. in depth. Tripods made of 2-in. pipe, and provided with block and tackle, are used to facilitate handling. Quarter-octagon steel, of ⅞-in. diameter, is used for jackhammers, and 1¼-in. hollow-round steel for all Leyner holes. Length and gage of drill steel used are given in Table IV.

Table IV—Length and Gage of Steels Used in Drilling Holes by Machine

Service	Starters: Length, Feet	Starters: Gage, Inches	Number Changes	Finishers: Length, Feet	Finishers: Gage, Inches
Plugging	2½	1¾			
Jackhammers	2½	2¼	12	20	1¼
Leyners	2½	2¼	19	30	1⅜

All drill steel is sharpened at the main drill sharpening shop on the 500 level and handled to and from the various benches by means of a White truck, which operates on the standard-gage track. Drill repairs are handled in a small shop near the pit.

Machines Cheaper Than Churn Drills in Diorite

Machine drilling has replaced churn-drill holes in the diorite because of the difference in drilling costs. In hard rock, a Leyner will average 3.7 ft. per hour, whereas a churn drill will average only 0.5 ft.

Vertical holes are drilled from 10 to 15 ft. apart, depending on the ground. The depth will vary from 21 to 30 ft. and the burden from about 16 to 20 ft. Drilling speed will average 3.7 ft. per hour, or 12 ft. per man-shift, with a labor cost of $0.42 per foot. Powder charge will average 112 lb. per hole. The percentage of holes lost by caving and because of broken and stuck steel will run as high as 35 per cent.

Toe holes are used in combination with the vertical Leyner holes and will average 18 ft. in depth. They are spaced from 6 to 15 ft. apart, depending on the character of the bank, and are drilled so that the bottom of the hole will be 2 or 3 ft. below grade.

Drilling speed will average 3.5 ft. per hour, or 17.3 ft. per man-shift, with a labor cost of $0.22 per foot.

Powder charge will average 140 lb. per hole. The percentage of holes lost because of loose ground, broken steel, and similar mishaps will average 20 per cent.

After a series of toe and vertical holes have been drilled, they are sprung with two or three sticks of powder in the bottom of the hole, then with six to ten sticks, and again with eighteen to twenty-five sticks. The chamber after the third springing is usually of sufficient size to hold the required amount of powder.

Toe Holes Loaded Quickly by Machine

Four to six sticks of 50 per cent gelatin are then placed in the hole after inserting a No. 8 electric blasting cap in one of the sticks. The bag powder is then loaded by use of an air loading machine, shown in Fig. 1. The powder is delivered from the gun to the bottom of the hole through a brass tube which permits the air to escape without carrying along a portion of the charge. This loading device will handle 150 lb. of powder in three minutes, whereas formerly about twenty minutes was required to load a 50-lb. box of stick powder. This method applies only to toe holes, the vertical holes being loaded by use of a funnel. After the holes are all loaded, they are tamped with any fine dirt that is handy, connected in parallel, tested with an ohmmeter galvanometer, and shot with 440 volts a.c. current.

A comparison of the yardage, powder and labor costs of the two methods is shown in Table V.

Table V—Drilling Costs With Churn Drills and Machines

	Churn Drilling	Machine Drilling
Powder per cubic yard broken, pounds	0.386	0.398
Cubic yards per pound of powder	3.08	2.99
Cost of explosives per cubic yard broken	$0.062	$0.064
Direct labor cost per cubic yard	$0.078	$0.114

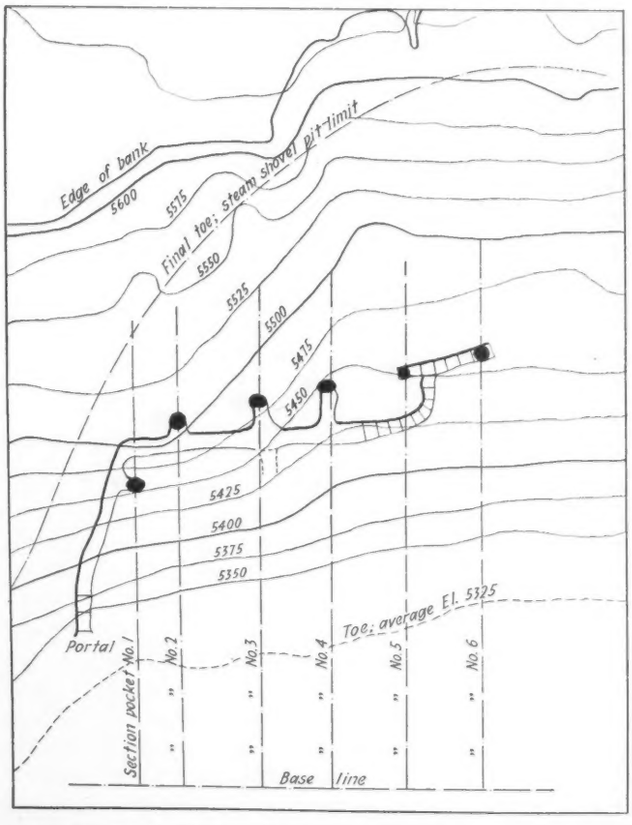


Fig. 2—Plan of development for coyote blast No. 2, at United Verde mine

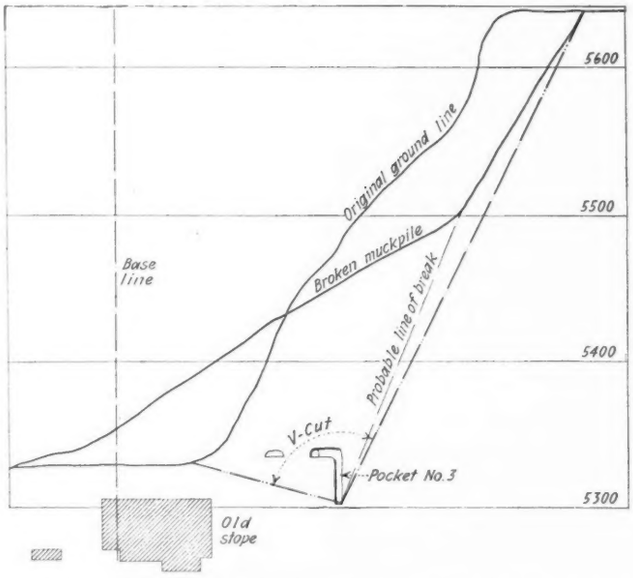


Fig. 3—Section of pocket No. 3, coyote blast No. 2, United Verde mine

Coyote blasting methods are applicable to high banks in waste where no sorting is necessary. Original plans called for stripping the massive diorite from the west side of the pit by a series of 50-ft. benches, and the use of two 4-cu.yd. railroad-type shovels. It was found that stripping operations would delay the opening up of the pit on the 160 level, so that 50-ft. benches were merged into one slope 320 ft. in height on the southwest wall of the pit and broken waste was handled from the 160 level by the 8-cu.yd. Marion shovel, which has a 90-ft. boom and can work against a bank of this height. The general method of development is shown in Fig. 2, and a section through a typical pocket in Fig. 3. To date four such coyote blasts have been successfully fired.

Drifts and crosscuts for coyote blasts are driven 4½ by 6 ft. in cross-section, using Ingersoll-Rand 248 air drills. Pockets for holding the explosive charge are 5x5 ft. in cross-section and are sunk to depths varying from 13 to 30 ft. If a large charge is to be placed in a pocket, the bottom is belled out so that the charge will be concentrated at the bottom of the pocket. Table VI shows the development work done in preparing the four coyote blasts which have been shot to date.

Table VI—Development Done Preliminary to Coyote Blasts

Item	Number of Coyote Blast 1	2	3	4
Number of pockets	7	6	14	10
Average distance between pockets, feet	30	30	30	30
Average depth of pockets, feet	15	30	19	16
Drifting and crosscutting footage	305	305	645	526
Sinking footage	105	180	265	160
Average distance pocket to toe of bank, feet	78	100	133	65
Average vertical height above pocket, feet	121	167	189	146
Average area of V-section through each pocket, sq.ft.	4,500	7,760	11,720	4,800
Average burden on each pocket, cubic yard	5,000	7,800	9,800	6,000

It may be noted that in the first three blasts the coyote workings were started from the face of the bank. In the fourth blast all work was carried from behind the bank by utilizing an old adit. Burden, as referred to in the foregoing table, is that yardage above grade, in front of a vertical plane through the rear of the pocket and extending halfway between pockets.

Herco blasting powder was used in the first three blasts. In the fourth Quarry Special, No. 6, manufactured by the Apache Powder Co., was used. Herco

powder comes packed in 25-lb. kegs, and the Quarry Special powder is packed in cases, each case containing four 12½-lb. bags. In loading the pockets, the powder was emptied from the containers and trammed to the pocket in special canvas-lined cars. Fifty per cent gelatin was used as a primer in all the blasts in amounts varying from 4 to 13 per cent of the total charge, depending upon the character and structure of the rock to be broken.

Four No. 8 electric detonators are used for capping out each pocket. These are inserted in a box of 50 per cent gelatin and the box is placed in the bottom of the pocket. All lead wires are connected to No. 6 or No. 8 insulated copper wire at the bottom of the pocket. All pockets are connected in parallel circuit. The lead wires are inclosed in old rubber hose and suspended from the back in the drifts. The wires are further protected in the pockets by wooden conduits extending down the sides. As an added precaution against misfire, a line of Cordeau is run through the workings, connecting all the charges and coiled in the bottoms of the pockets. After backfilling is completed the ends of the Cordeau are capped with No. 8 electric detonators and connected to the main circuit.

In loading the pockets the 50 per cent gelatin is first lowered into the pocket and scattered around the primer and the coiled Cordeau. The main charge is then dumped into the pocket. As soon as a pocket is loaded, the explosives are covered with heavy paper and tamped with several cars of sand. Backfilling is then started, the drifts and crosscuts being completely filled with waste material to a point 30 to 50 ft. behind the last pocket. The back-filling is handled in 18-cu.ft. end-dump mine cars. During the progress of back-filling, the blasting circuit is tested every fifteen minutes with an ohmmeter galvanometer, so that any breaks may be readily detected and remedied. When back-filling is completed, the shot is fired instantaneously with 440-volt a.c. current.

Table VII gives comparative data regarding the four coyote blasts.

Table VII—Loading and Back-Filling Time, Powder Used and Yardage Broken in Coyote Blasts

	Number of Coyote Blast			
	1	2	3	4
Loading time, hours	8	6	16	22½
Back-filling time, hours	64	116	136	145½
Cars back-filling	560	995	1,843	956
Pounds black powder	100,000	95,400	250,000	.....
Pounds Quarry Special	.....	.....	.....	91,700
Pounds 50 per cent gelatin	13,050	3,500	9,900	11,650
Cubic yards broken	140,000	135,000	259,000	105,000
Cubic yards broken per pound total explosives	1.24	1.36	1.00	1.02

In the first and fourth coyote blasts, the rock in certain areas close to the fire zone was very hot. Great care was taken in the fourth blast not to cut any pockets where the rock temperature exceeded 120 deg. F.

The average cost per cubic foot of rock broken by the four coyote shots is as follows: Cost of development, $0.083; cost of explosives, $0.082; and labor, supplies, and miscellaneous, $0.011; total, $0.176.

Secondary Blasting—Block-Holing

Secondary blasting consists in breaking up the large boulders into sizes suitable for loading into dump cars or motor trucks. If this can be done without delaying the shovel, the oversize pieces are drilled and shot. This is called block-holing. Where the time element is of more importance than the cost of the powder used, the boulders are "dobeyed"—that is, the powder is laid directly on the piece to be broken and covered with fine dirt and clay or mud. The powder consumption and cost per cubic yard broken for secondary blasting are 0.135 lb. and $0.029 respectively.

Work Done on Bonus Wherever Possible

Wherever possible, pit operations are placed on bonus, which is handled by one engineer under the supervision of the mine bonus department. Because of the variable ground conditions, it has proved difficult to place the drilling on a footage basis. The bonus rate of all drilling and blasting is now on a yardage basis. These rates are changed from time to time to fit working conditions. At present, the drilling and blasting for the 50-B 1¾-cu.yd. shovels are based on a 16c. per cubic yard rate; the 4-cu.yd. shovels, 8c. per cubic yard; and block-holding muck for the 8-cu.yd. Marion is on a 3c. per cubic yard rate.

Mill-Hole Mining an Old Method

Mill-hole mining methods have been used at this mine for at least fifteen years. The ore on the southerly border of the fire zone was mill-holed to the 80-ft. level and the schist ore passed down through raises to the ore pockets on the 1,000 level of the mine. Oxide, because of its sticky character, was lowered through No. 4 shaft to the 900 level, where it was dumped into a bin leading to the 1,000 level.

A system of raises and branch raises has been extended from the 1,000-level ore bins to the surface. A number of these will serve the shovels and the rest will be mill-holed where this method is applicable.

In mill-hole work, an initial cut is taken at the bottom of the hole and the cut advanced around the circumference of the hole. Successive cuts are taken, working from the bottom upward until a more or less uniform slice has been taken off of the entire mill hole. This procedure permits holes to be drilled horizontally or upward. It also has the advantage over the method of starting at the top and working down, in that no muck is blasted down on the benches or slope directly below, thereby requiring considerable hand-mucking before the next cut lower down can be drilled.

The drilling and blasting is done in exactly the same manner as described for toe holes. Ordinarily, 35 per cent stick powder is used rather than the bag powder, which requires a gun for loading. The depth of the holes and amount of powder used depend entirely upon physical conditions of the bank being shot and the character of the ground.

Cost per cubic yard of mill-hole mining is as follows: Explosives, $0.060; labor, $0.161; repairs, $0.039; and miscellaneous, $0.040; total, $0.300.

Lead Production in Idaho Increased in 1925

The production of lead in Idaho increased from 260,356,490 lb., valued at $21,081,065, in 1924, to 265,302,800 lb., valued at $23,930,319.78, in 1925, a gain of 4,946,390 lb. and an increase in value of $2,849,254.78. The increase in value was due to the higher price paid for lead in 1925; the price averaged 8.097c. a pound in 1924 and 9.02c. a pound in 1925. Shoshone County furnished 95.52 per cent of the total, with a production of 253,327,957 lb., or approximately 22 per cent of the total lead production of the United States.

feared by the prospector, if not by the skilled promoter, and largely because of the fact the miner has to deal with an alien business species, the lawyer, with whose language the miner is unacquainted and whose knowledge of the technique of exploration and development of mines is practically nil. It is generally impossible to meet on common ground. Hence comes into being the promoter, who generally combines a working knowledge of the two spheres of activity, but is seldom an expert at either and is more properly classifiable as a financier. There is a vital distinction between promoters and prospectors.

By the time an itinerant prospector has made a discovery and developed ore at a cost of several years of work and the expenditure of all of his surplus funds, and has successfully interested some man of relatively small means but voracious speculative appetite to finance him in securing a lawyer to incorporate and to advance funds to pay the heavy fees demanded, and has secured a promoter to underwrite or sell his shares, and finally has reached the door of the blue-sky commissioner, it may be generally postulated that the equity of the original discoverer is apt to be somewhat minute. Indeed, blue-sky commissioners seldom see men of the discovery type, but deal with the promoters, who are middlemen in fact.

Now, blue-sky legislation aims at "paternalistic promotion plus public protection," while the prospector is faced with the need of getting a living and a reward for his work in the field of mineral exploration. Hence, in the article referred to, the idea sought to be conveyed was that "it is clearly equitable to allow a fixed percentage of the stock of a corporation allotted to a prospector to be sold for cash on his behalf and the money actually paid him for his services."

If an escrow pool has been established, obviously this should not be the entire amount of his interest in the pool (if the escrow system be continued, and it is not the purpose of this discussion to pass upon the moral and equitable validity of the escrow system), but it should be, at least, an equivalent proportion of a prospector's allotment, as is now allowed to the stock salesman for his "selling expense," which is fixed in some jurisdictions at a 20 per cent basis on all stock sold.

In a concrete case, assuming a million-dollar corporation, with 60 per cent of all stock in escrow, of which the original discoverer's portion is 150,000 shares, the promoters, lawyers, and underwriting financiers taking the balance up to the 600,000 total, and leaving 400,000 in the treasury for public sale, then, for the public flotation of the treasury stock of 400,000 shares, assuming its sale at a par of $1, the selling expense would be 20 per cent of $400,000, or $80,000, and it should be most equitable to allow the prospector to have sold for his benefit 30,000 shares of his 150,000 shares in the pool, which, assuming the selling expense of 20 per cent, would leave him $24,000 for his time and trouble as a cash reward, and 120,000 shares remaining in the escrow pool. This, it is contended, would be a most equitable procedure.

Indeed, could the original location and discovery act be rewritten (which it cannot), it would be highly desirable to attach a "vested right" of discovery in all prospects to the extent of 20 per cent of all ores on each and every claim (the King's Royal Fifth), which would standardize these matters in a nutshell, as far as the stimulation of prospecting is concerned. However, it is too late for that remedy, and the next best protective method would seem to be the safeguarding and liberalizing of the prospector's individual holdings and the making of a series of regulations under which some financial reward shall come to him. The object of this philosophy is to stimulate prospecting and provide more new mines and jobs for our citizens and the maintenance of our country's supremacy in metal production—to give the red-blooded man a chance under the blue sky.

HAROLD LEE GAGE.

Salem, Ore.

Route to Red Lake

THE EDITOR:

Sir—In the Discussion section in your issue of May 1 a letter appeared under the heading "Prospecting in Northern Canada," regarding routes into the Red Lake district. Any one going into this district from the Middle West or from the Western states had better come to Winnipeg first and then go in either by way of Hudsons, or else by way of Bird River or the Long Lake or the Bull Dog Lake route. Those from the Eastern states should go by way of Toronto.

A tale going the rounds of mining circles here in Winnipeg is that of three men from Warrod, Minn. (not much over 250 miles in a straight line from Red Lake), went first to Minneapolis, then to Chicago, then to Detroit, and on to Toronto; then back in a westerly direction 1,200 miles to Hudsons. By going in by way of the Bird River and Long Lake a prospector could prospect on the way in and probably find something as good on the Manitoba side of the border, which really belongs in the same district. The Manitoba branch of the Canadian Institute of Mining and Metallurgy, through its officers, would gladly give anyone authentic information regarding these districts.

FRANK M. OLIVER.

Winnipeg, Man.

Genesis of Sulphide Ores

THE EDITOR:

Sir—As a superficial observer of the genesis of ore deposits it appears to me that deposition may be wholly mechanical. We may assume that any liquid such as water under pressure will hold in solution all or any of the metallic sulphides, oxides, carbonates, sulphates, or hydrates, and that there is a critical point of pressure for each substance when it separates or precipitates, irrespective of the pressure of H_2S, CO_2 or any other precipitant.

Many ore deposits that I have exploited to my limited knowledge cannot be formed by any of the numerous theories now current, but this simple theory appears to fit these cases. The most puzzling ore deposits are those lying at or near the surface with no continuity underground. Here we may consider that the ore-carrying solutions were under great pressure until near the present surface, when the pressure was sufficiently released for deposition. The pressures in deep-seated regions where the sponge (earth) is squeezed to liberate water or liquid gases we cannot duplicate, so I fear it would be difficult to prove or disprove this idea.

Mr. Freeman's papers are very interesting, but rather too complex for the miner, who requires a simple theory that is understandable but not necessarily provable.

ALGERNON DEL MAR.

Victorville, Calif.

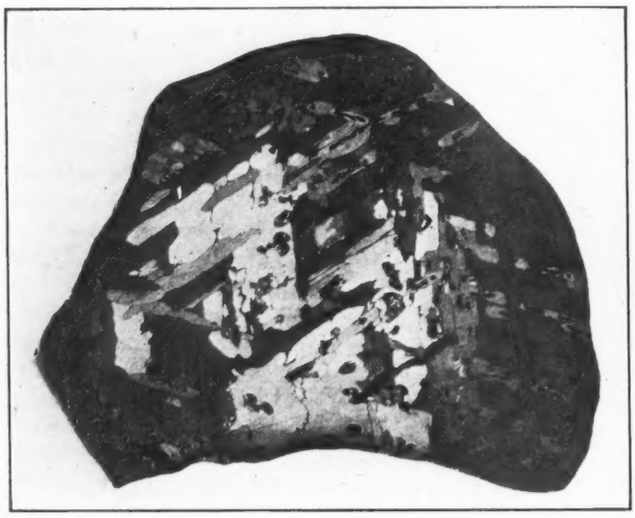
Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief. Letters will not be printed unless the author's name and address are known to the editor.

A Small Meteor Crater in Texas

THE EDITOR:

Sir—The several references to meteorites in recent numbers of the *Engineering and Mining Journal-Press* have reminded me of an experience in western Texas in 1921 while I was engaged in a search for evidences of potash and oil in Ector and Crane counties. A ranchman at Odessa produced a sample of "iron ore" which he had picked up thereabouts on the edge of a



Fragment of meteoric iron from Texas crater, photographed by 45-deg. illumination after polishing and etching

so-called blow-out. A simple test showed that the sample was meteoric, and the ranchman took us to the spot where he found the iron. A few minutes' search about this point sufficed to check up the report by the finding of another fragment. This also lay near the edge of the blow-out, the latter being roughly circular in outline, a few hundred feet in diameter and 10 to 30 ft. in depth. At the point where the iron was found there seemed to be more or less rock débris overlying the bedrock, which in this region elsewhere lies virtually horizontal. At one point on the margin, however, where the bedrock was exposed and on the same side where the iron occurred, it was found dipping rather steeply away from the center of the blow-out. The visit being a hurried one, this was about all we were able to observe as to occurrence. The iron was placed in the hands of Professor Merrill, of the U. S. National Museum, for study, and was described by him in the *American Journal of Science*, Vol. III, May, 1922.

One of the slices made by Professor Merrill I deposited in the Maryland Academy of Sciences. This was later studied by Professor L. E. Jewell, of Rochester, who for many years was associated with the late Professor Rowland, of Johns Hopkins University, in the development of his world-renowned "gratings" on speculum metal (with twenty to fifty thousand distinct lines to the inch). The illustration is reproduced from one of Professor Jewell's photographs by 45-deg. illumination after polishing and etching by a new method of his own.

A. B. BIBBINS.

Baltimore, Md.

Blue Sky and Red Blood

THE EDITOR:

Sir—The article entitled "The Prospector and the Blue-Sky Law," published in your Jan. 23 issue and subsequently commented upon by sundry writers, has been misinterpreted in several particulars. It seems necessary to state the prospectors' case more clearly.

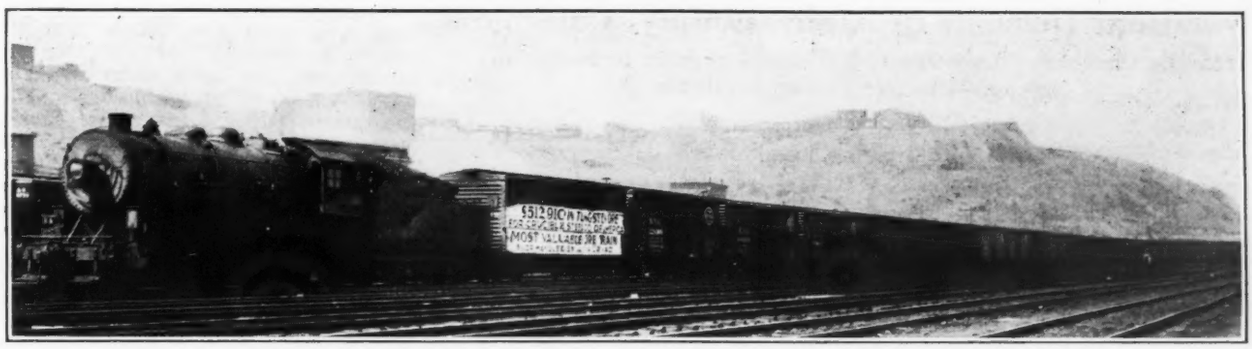
In various camps are to be found itinerant miners who work winters and prospect summers. These men have no financial backing other than their own earned income, yet possess the physical strength, the practical knowledge, and, of late years, with the accession to their ranks of a sprinkling of technically trained men, the scientific training necessary to prospect intelligently.

Since it is well known that exploration companies prefer to consider only prospects with a reasonable assurance of sufficient mineralization to make them large units eventually, the burden of the primary development in new districts falls upon the shoulders of these itinerant prospectors. Of late years, they have dwindled in number until we have, in Colorado, the peculiar circumstance of a business men's organization paying men to prospect on a wage basis plus an interest in the ore found.

The economic reasons back of the cessation of individual free-lancing are many. Among them are: The fact that winter employment does not yield net earnings sufficient for an adequate summer grubstake; higher cost of supplies and transportation during the prospecting season; lack of adequate areal geological surveys to aid in deciphering complex rock systems; attempted restrictions on public-land exploration by grazing and forestry interests; inadequate road development through mineral-bearing territory; increased cost of incorporation and promotion of small companies; overzealous propaganda of the "6 per cent and safety bond salesman," and, finally, the blue-sky laws.

Any one of the foregoing reasons supplies a handicap which is hard for the average "poor" prospector to overcome. Combined, they constitute a series of hurdles which have operated to restrict the field of exploration and the development of small mines markedly. Their net effect has been to close the door of opportunity for the individual prospector and to effect the concentration of the industry in large companies.

One of these hurdles, the blue-sky law, is greatly



Twenty cars of tungsten ore from China left the docks at Weehawken, N. J., May 26, for Niagara Falls, over the New York Central R.R. It is owned by the Crucible Steel Company of America.

bagged for its 10,000-mile journey to the markets of the world.

"Coolies with shoulder poles carry the ore in two bags of 100 lb. each from the concentrating plant to the river, where it is loaded on sampans. These little boats, because of the shallow river, can carry only one ton each, and many times on its long journey to Shanghai the ore is transferred to larger and still larger boats. At the beginning of the river journey even the small boats often have to be poled off sand bars in the stream."

The Chinese deposits of tungsten have been known about ten years. The tungsten mines in China now produce more of this ore than any other section of the world. The first deposits were discovered in the southwestern part of Kiangsi by a German priest, but it was Chan Ku Lee, of the Kong Ku On Mining Co., who was the first to locate deposits in northern Kwong, from which large quantities are shipped.

Tin Mines to Be Reopened

After being closed for nearly twenty-five years, the Temescal tin mine has been reopened, according to a report from Corona, Calif. The ore was discovered in 1850. The property passed to a London company in 1890 and was closed by its British owners in 1892 owing to the low price of tin. A recently organized American company has resumed operations.

It is reported that a Chicago company has purchased the Tinton mining properties, Tinton, S. D., and plans to start operations. Tin and mica are the products of the property. With tin now worth 60c. a pound, and with a new mica separation process perfected, the operators of the mine feel that there is a possibility of profitable operations.

Stevens Mines Under Exploitation

Colonel Victor Hugo Duras, of Washington, D. C., has arrived at Silver City, N. M., to take charge of and handle the mining properties of the late C. Amory Stevens, of New York. Colonel Duras will operate a part of the mines in his own behalf and that of the heirs of the estate. He will offer some of the other property for sale. The Stevens property includes a large number of patented claims scattered throughout Grant County. Included in the group is the Chloride Flat mine, on the outskirts of Silver City.

Red Lake Mining Division Enlarged

The inclusion of the Birch Lake and Woman Lake areas in the Red Lake Mining Division of Ontario has rendered necessary the removal of the mining records for those areas from the office at Kenora to the new recording office at Pine Ridge, Ontario. The Red Lake office is to be established at Pine Ridge on June 10. So far nearly four thousand claims have been recorded at the Kenora office from the Birch Lake and Woman Lake areas.

Tax Returns Reveal Prosperous Year for Idaho Mines

Annual reports of mining companies in the Coeur d'Alene district filed with the county assessor, as required by the Idaho law taxing net profits, show the gross value of mineral production in 1925 was $24,255,046 and that net profits were $8,781,760. This compares with gross value of $22,436,286 and net profits of $6,543,701 in 1924. Net profits of the three largest producers in 1925 were: Bunker Hill & Sullivan, $3,362,530; Hecla, $2,801,410; Federal (Morning mine), $2,269,334.

An Aluminum Plant for Istria

The Milan Montecatini Co., the largest sulphur producer in Italy, intends to erect a plant for the manufacture of aluminum at Cotrone, near bauxite deposits in Istria. The bauxite deposits are idle at present on account of the prohibited exportation of bauxite by the Italian Government.

Old Mine Dumps to Be Milled for Lead

The Cooks Milling Co. has completed its 50-ton mill for treating the old dumps and stope fills at Cooks Peak. Cooks Peak is an old lead camp 30 miles north of Deming, N. M. There is a large tonnage of low-grade dumps that have heretofore been considered impossible to concentrate. The ore occurs principally as carbonates and has a minor percentage of zinc carbonates. The dumps assay from 2½ to 9 per cent lead. Operations have been favored by an exceptional spring rainfall. J. J. Murray is in charge.

Abana Drills Encounter Good Ore

Diamond-drilling operations on the Abana property, Rouyn, Quebec, have met with successful results. A circular issued by the company's engineer states that diamond drilling which cut the ore at 150 ft. below bedrock has encountered good values. Within a distance of 130 ft. four bodies of ore were cut. The first encountered was 13 ft. 4 in. wide, and averaged $24 per ton, with principal values in chalcopyrite with little or no zinc sulphide. The next ore encountered was 52 in. wide, and averaged $22 per ton. This was followed by another one 46 in. wide, averaging $25 per ton, and the last lens was 96 in. wide, and averaged 26 per cent zinc, no copper, and $3.18 in silver. Gold values ranged as high as $5.20 per ton, and silver values as high as $5.70. The gold and silver content appear to increase in depth, as well as the copper and zinc values.

Granby Bonds Redeemed

Through a private arrangement the American Zinc, Lead & Smelting Co. has provided funds for redemption of Granby Mining & Smelting Co. 5 per cent bonds due June 1. There are $900,000 of these bonds outstanding, which were assumed by the American Zinc in its merger with Granby some years ago. Prior to arranging its borrowing it had current assets of practically $1,500,000 over liabilities, including the $900,000 maturing bonds, and could have retired its Granby bonds from working capital.

Mohawk Completes Fourth Grinding Unit

With the completion about June 1 of the fourth regrinding unit in the Mohawk stamp mill, in the Michigan copper district, the regrinding of the tailings of all four stamp heads will be possible. This will yield a pound or more of copper per ton of sand reground. Regrinding of amygdaloid tailings now is general in the district, as it is the most feasible way of reducing losses in stamp-mill treatment. Mohawk is making a recovery of 26 lb. of refined copper per ton of rock treated. Inasmuch as No. 2 shaft, Seneca, has good values to the south toward the Mohawk boundary, it is believed No. 1 will show an improvement in values with greater depth.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

TRANSVAAL mining costs lowest in nine years—Strike in Great Britain delayed publication of mining company reports—Waihi mine nears end.

Granby Mining & Smelting redeems bonds—Tax returns of Idaho indicate prosperous year for Coeur d'Alene mines.

Giesche purchase completed by Anaconda-Harriman companies—Harvard offers new metallurgical course.

Liberalization of war minerals act tabled by House Mines Committee—Potash bill pending.

Low-grade silver-gold deposits of Alpine County, Calif., may be worked.

Federal Mining unwaters old Duenweg-Joplin field and plans extensive development—Eagle-Picher purchases Martha B mine—Drought retards mining in Joplin-Miami district.

Kirkland Lake, Ontario, an outstanding gold camp with promising future—Bunker Hill & Sullivan contemplating electrolytic zinc plant.

Katherine Gold Mines, in Arizona, will reorganize—President of United Verde extension against copper tariff.

Callahan Zinc to build 150-ton flotation mill to treat silver-lead ore.

Half-Million-Dollar Shipment of Tungsten Arrives from China en Route to Niagara Falls, N. Y.

Transported by Coolies to River, and 500 Miles on Yangtsi River to Shanghai—Political Conditions and Robbery Hamper Production

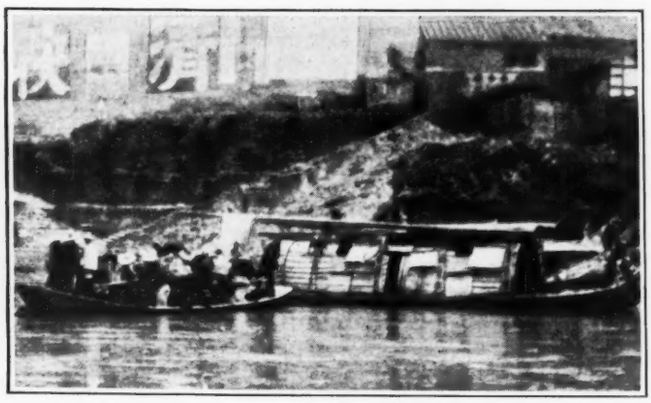
ON MAY 26, 1926, tungsten ore valued at $512,910 was shipped in twenty cars from Weehawken, N. J., to Niagara Falls, N. Y., over the River Division of the New York Central R.R. It was consigned to the Electro Metallurgical Co. for the account of the Crucible Steel Company of America. The ore (concentrate) came from the interior of China, 1,100 miles from Shanghai and 600 miles north of Canton.

W. F. Carman, vice-president of the China Commercial Co., of New York, through which firm the shipment was imported, has had some dramatic experiences in the country from which the tungsten came. Robbers, kidnapers, revolutionists, and shallow rivers make up the few of the trials through which the tungsten miner and transporter is forced to make his way with his valuable cargo. Last year, while traveling out with a cargo of ore from the mines, his party of fifty boats had tied up in the middle of the river when they were boarded during the night by robbers. Guards saw them, however, and subdued the intruders before they could do harm. Recognizing the power of the robbers of interior China, the company operating the mines employs a man for the sole purpose of subsidizing the bandits as well as the government that happens to be in power at the moment, else they would never get their material from the interior to the rivers for transport to the distant seacoast.

The almost incessant internecine troubles in the south of China have had a serious effect on the mining of tungsten, and property after property has been abandoned, the main source of supply for the last two years having been the Shi Wai Sham district. At first shipments were brought down over the mountains direct to Canton, but the growing disorders in the south caused the abandonment of this route. In one instance the company was forced to pay $50,000 ransom to bandits for the release of five of its men. Shipments were later brought out by way of Nan Chang, Kiukiang, and down the Yangtsi River to Shanghai.

"Interruption to transportation," says Mr. Carman, in speaking of the mining of tungsten in China, "is one of the most serious obstacles with which the Chinese miner has to contend. When the ore leaves the mine it is carried 15 miles down the mountain to the concentrating sheds, where it is crushed, after which it is dried, sampled, and

Coolies carrying tungsten ore from the mines to the river



Transporting tungsten ore on the river

Silver-Gold Deposits of Alpine County, California

May Be Considered Low-Grade, But Are Amenable to Flotation Process—Electric Power Available

By John L. Henry
San Francisco, Calif.

ALPINE COUNTY, California, on the eastern slope of the Sierra Nevada Mountains, has been of little mining interest of late years, but at one time it had several mining villages and some gold and silver production was made. Partly on account of its comparative isolation and also by reason of the low-grade nature of the principal deposits, whatever mining possibilities there were have been neglected, but the present progress in milling now opens out certain opportunities of treating low-grade ores by flotation, the concentrates to be shipped to the usual outlets for local treatment by cyanide or other hydrometallurgical method.

The Monitor and Mogul districts are important in that large low-grade silicified deposits exist there, and these are now under investigation to determine the feasibility of their exploitation. A. S. Eakle made a geological study of the district, and the following quotation from a report by him gives the important features:

"The Monitor and Mogul districts have been the most important, and more recent work has been done in them. This report is mainly devoted to these two principal districts, for any future mining in the country will probably be done in them. The two principal hills from which ore was formerly mined are the Colorado Hill and the Morning Star Hill. The principal claims in the Monitor district are located on Colorado Hill, and the principal claims in the Mogul district are located on Morning Star Hill.

"This particular section of the country is wholly volcanic, and the rock is andesite of Tertiary or later eruptions. The main country rock forming the hills containing the orebodies is a compact and somewhat porphyritic andesite. . . . Much of the rock is very coarse breccia or agglomerate, with large fragments of grayish andesite cemented by ash and cinder, forming coarse tuff-breccias.

"There is no section of California in which silicified bodies of rock more or less mineralized have been found on a scale of such magnitude as occur in this section. The oxidation of their iron and manganese contents has given them shades of pinks, reds, yellows, brown, and black. . . . All of these silicified bodies are mineralized, and at the present time of profitably working very low-grade ore, all of them may be classed as orebodies. The sulphide solutions contained arsenic and antimony, with the result that the sulpho-salts are prominent in the ores as well as the common sulphides such as pyrite and galena. The sulpho-salts occur probably in the higher portions of the deposit, with the sulphides predominating below. Pyrite is the commonest of the sulphides and is disseminated throughout the mass in crystals and grains and contains gold in small amounts."

The production of the Monitor area has been about $1,000,000, of which more than $600,000 was extracted from Colorado Hill. The most important claims on this hill are now owned by the Colossus Silver & Gold Mines Association, the members of which are principally residents of Alpine County. Recent work in these mines has proven a mineral area of 1,100 ft. in width. From the road in Monitor Canyon to the outcrop there is a vertical workable distance of more than 900 ft., and this area has been penetrated by tunnels through the zone of mineralization, two of which are 1,400 ft. and 1,700 ft. in length, respectively, and by an upraise to the croppings. All of this area is mineralized, the croppings themselves showing gold and silver values of about $2.90 per ton. It is believed that the whole mass has an average tenor of $2.25 in silver and gold, silver predominating in the ratio of 58 per cent silver to 42 per cent in gold by value. However, it will be necessary to undertake attitional systematic development before the actual value distribution can be conclusively determined. Recent work has opened up some of the richer classes of ore, principally argentite, for which these mines were at one time worked. Float lying on the hillside carries an average of $2 per ton.

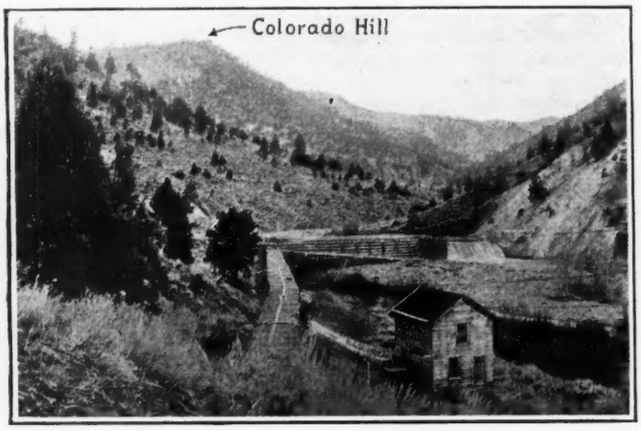
The situation as now evidenced brings these Colorado Hill mines into the class of open-pit workings, without overburden, and with water available in the Carson River, within one mile of the mines, where also electric energy can be produced, low operating costs should prevail. The ores are suitable to treatment by flotation, and a satisfactory recovery appears to be now proved as far as preliminary tests show.

In Goskey Canyon, about 1½ miles from the Colossus mines, a promising silver-lead property is being developed, the ore being a coarse galena carrying from 30 to 40 oz. of silver and a small amount of gold and copper in the form of chalcopyrite. Sacking of this ore is in progress. In the Silver Mountain region, a recent discovery in the granite formation of that area has disclosed a vein nearly four feet in width, the average tenor of which is high in gold and silver, the gold predominating. San Francisco capital has been secured to open up this prospect.

Owing to the discovery that the entire width of the Colossus claims on Colorado Hill is mineralized from the croppings downward, and that large-scale operations are probable, the interest being taken in smaller prospects in Alpine County is assuming a far greater importance in mining than for many years. Successful tests made by flotation on the low-grade ore, which hitherto failed to yield to amalgamation and chlorination, have raised hopes that mining operations have reasonable chances of success.

Good roads made within the last few years have tended to facilitate mining operations, which may be conducted throughout the year without interruption. The county seat, Marklevil'e, affords good accommodations for travelers. Opportunities for hydro-electric power development are promising.

View of Markleville, Alpine County, Calif.



East Carson River, with dam for power plant

Spring Mine Resumes Shipments

The Spring mine, four miles east of Mesaba, Minn., opened more than twenty-five years ago by G. A. St. Claire, of Duluth, will be operated this year by the Kingston Mining Co., of Eveleth. The pit is now being dewatered, and further stripping is scheduled for this season. This mine changed owners frequently until 1923, when the Kingston company installed a Dorr washer and shipped 25,000 tons.

News From Washington

By PAUL WOOTON
Special Correspondent

Liberalization of War Mineral Act Tabled by House Committee on Mines and Mining—Potash Bill Awaits Action

BY A VOTE of 7 to 4, the Committee on Mines and Mining of the House of Representatives has tabled a motion to report favorably on Senate Bill No. 3641, which proposes to liberalize, in a very material manner, the existing War Minerals Relief Act. This action probably ends any further attempts at liberalization of the act.

Bill Opposed by Secretary of Interior

The committee took its final action after the receipt of a further report from the Secretary of the Interior in which he takes the position that "the adjustments which have been made under the act and its amendments, in the years which have elapsed since the war, have done substantial justice to all claimants." Secretary Work further holds that there is not "sufficient warrant for enlarging the act and entering upon a course of re-examinations and readjustments which would entail a heavy drain upon the Treasury of the United States."

Not Explicit in Wording

In one of the sections of the bill the way is opened, Secretary Work believes, to extend relief to all the war minerals. In his report to the committee he points out that in Section 3 of the bill the four minerals in the present act are not named "but are referred to as 'necessaries,' that term being used in the original $50,000,000 act which provided for increased production and distribution of half a hundred ores, minerals, metallurgical products and chemical compounds, all of which were called necessaries. If the purpose of thus connecting the present legislation with the National Defense Act is not to lay the foundation for the admission of losses on other minerals than those named in the War Minerals Relief Act, and for the admission of alloys or manufactured products, then its intent is not clear. As to the entire section, it may be said that if its only purpose is to validate losses on purchase of property and interest payments, the purpose ought to be stated in plain, unmistakable terms. And as to interest, it should be made clear whether usurious interest, which may have been exacted during the war, is to be reimbursed, or only an amount which would represent lawful interest actually paid or due to be paid. It should also be made clear that 'interest' is not to be held to mean bonuses or commissions paid in addition to interest in the securing of capital."

Unwarranted Claims Invited

Secretary Work also points out that Section 4 of the bill may be far reaching. In that connection he says:

"In the adjustment of claims under the existing law, claimants who had filed their claims, or given notice of intent to file within the time prescribed in the act, were permitted to amend the filing, in any particular, the only restriction being that they confine the amendment to the operation described in the original filing. They were not permitted to include other operations which would, in fact, constitute a new claim. Section 4 provides that any claimant who suffered net losses which were not included in the claim as filed, because not known at the time of filing, may amend the claim within thirty days from the passage of this bill, and it will then be mandatory upon the Secretary to adjust the amended claim under the limitations of the act. This amendment is far-reaching and would be correspondingly costly. It would permit claimants who were awarded and paid their net loss to the time of the armistice to now show that the value they placed on the property and equipment for salvage purposes, or the value which was put upon it by the government, was not realized by them in the disposition of the property, and they would demand further reimbursement, notwithstanding that years have intervened since the adjustment, and that the property may have depreciated through use, age, or neglect. It possibly would be making the government responsible for bad management, changes in the conditions of the industry, in the years since the war, or many other things for which it should not be so held. As an illustration of the effect of this amendment, it may be said that one claimant filed a claim under the original act for losses amounting to $131,000 incurred in a mining operation in Minnesota; that the claim was prosecuted on this basis, and that it was not until late in 1922 that claimant sought to amend the claim to include three-quarters of a million dollars of alleged loss in an operation in a far-distant part of the world, no mention of which had been made in all the years in which he had been heard before the War Minerals Commission. Of course, it was denied as constituting a new claim. Section 4 would admit this new claim and compel its adjustment regardless of the provisions of the present law. Its enactment undoubtedly would result in the filing of many amendments. It has been estimated that to reimburse the purchase price of property and interest would cost the government $2,500,000. The adoption of Section 4 would vastly increase these figures."

The point also is made that "by stressing 'good faith' and 'justice and equity' it would seem to say that a strong showing as to these would govern and compel repayment, thus placing commercial importance and other requirements of the present act in the background."

Potash Bill Now Before the House

The bill providing for potash prospecting by the government is near the top of the unanimous consent calendar of the House of Representatives and probably will be reached promptly when that calendar is taken up on June 7. As amended by the House Committee on Mines and Mining, it is not improbable that the bill may be passed. It already has passed the Senate.

Oil Situation as Seen by Charles Evans Hughes

In an address before the Federal Oil Conservation Board, May 27, 1926, Charles Evans Hughes said:

"The nation does not face sudden failure of oil. Deeper drilling may greatly increase supplies. The considerable reserve from wells already producing, the deeper sands in those fields, are reassuring, but must be supplemented by continuous discoveries. The key to finding these reserves must be freely moving prices to induce men and capital to take risks. With these, the supply will long continue and transition to substitutes be without serious shock. Price finds the oil, produces it, and limits its use.

"Scientific effort holds the promise of the future. The cracking process has done more for conservation than any legislative scheme could do under our constitution. The government can accomplish much in stimulating and leading research. The oil industry is ready to co-operate in all practicable measures to promote research, to attain and diffuse knowledge, to stimulate invention. The keenest minds are studying processes, seeking improvement. This is of course motivated by intelligent self-interest. We are on the eve of important improvements in methods of production; in recovery of oil still below the surface within known fields; in utilizing what is produced; in promoting efficiency; in the development of substitutes. Political action is superficially attractive, but difficult and unlikely to succeed."

Indian Mine Owner Dead

Benjamin Quapaw, third chief of the Quapaw Indian tribe, and one of the wealthiest members of the tribe, died in a hospital at Miami, Okla., on May 25, following an operation. Chief Quapaw had long been a locally famous character in the Joplin-Miami district. Most of his wealth had come with the discovery of the rich zinc and lead deposits in Ottawa County. He owned several pieces of valuable land, and was half owner of the tract on which the Smith-Davis Ritz mine was located, and which sold at public auction a few months ago for $105,000 bonus, with 12½ royalty to the fee owners. Quapaw was born in Indian Territory and had lived all his life in Ottawa County. He had a fine home near the Devil's Promenade, just east of Lincolnville, and was highly respected by and popular with the white men who had occasion to have dealings with him. Old tribal customs were observed at the funeral held from his home on May 27.

Silver Discovery in Saline Valley, Inyo County, Calif.

By Thor Warner
Los Angeles, Calif.

SALINE VALLEY is in Inyo County, Calif., 30 miles northeast of Mount Whitney. It is a deep depression, between two of the many parallel mountain ranges that form the great subsidiary groups of the Sierra Nevada range. Its height above sea level is only 1,000 ft.; the higher peaks on Inyo range reach an altitude in excess of 10,000 ft.

The region until recently has been almost inaccessible, but it was visited by a few determined prospectors years ago. Completion of an automobile road from the Darwin-Keeler highway to the Saline Valley has opened the area to local mining men and has resulted in the discovery of silver ore. George Lewis, of Independence, Calif., made the discovery, and through him a business man of Owens Valley has become interested to such an extent that immediate purchase and installation of required mining equipment is already under way.

On the southwestern margin of the valley and at the foot of the eastern flank of Inyo range lies a steep and eastward-facing hill, and along this heavily eroded side hill are situated the several groups of mining claims forming the new camp. The area of interest to prospectors stretches along the foothills for six to eight miles. The present excitement centers on the Essex, Hudson, Silverado, Chuckawalla, Little Bobbie, and Craig Canyon groups of claims.

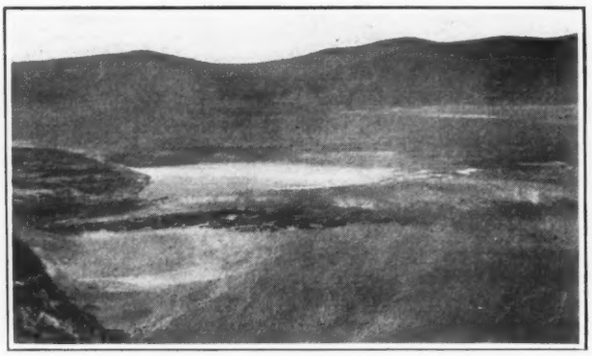
The district can be reached by a three-hour automobile ride over the recently constructed county road from Keeler, on the Southern Pacific R.R., or by another route, somewhat longer, by way of Big Pine, Calif. The distance from Keeler to the new camp is 48 miles, and is made with comparative ease. The only portion offering any resistance is a grade 10 miles in length where the descent from the summit of the pass to the valley level is approximately 5,000 ft. An aërial tramway, 12 miles long, passes within a quarter of a mile of the new discovery. This tramway leads from Saline Lake to a point on the western side of Inyo range, on the Southern Pacific R.R., and was constructed several years ago, to transport salt from Saline Lake to the railroad. It will now become a useful aid to the new discovery. A power line of the City Power Co. parallels the tramway.

With reference to the geological conditions it may be said that the intrusive formations seem to present two different kinds of material. The most extensive of the two is a fine-grained, dark-green hornblend-diorite that seems to be the major source of mineralization. The other is a granitic material, somewhat blending into the former, but may represent an alteration of the granite only. In the process of intrusion, these magmas greatly changed the sedimentary formations, marmorizing the limestone and altering the sandstone into a quartzite. This was followed by intensive erosion.

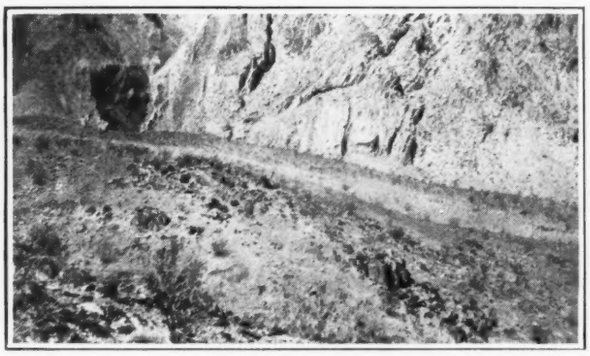
In the main area of fissuring and mineralization ore is prominently exposed along the bedding planes of limestone as well as in cross fractures and in the fissures cutting limestone and diorite formations. Invariably the most intensive enrichment of the vein system seems to be close to the contacts with the diorite. The width of individual veins ranges from a few inches to ten feet. The dip of the veins extending east and west is about 70 deg. to the south and veins having a north-south strike are nearly vertical.

A series of twenty-five samples taken along the outcrops for the purpose of determining the possible milling values of the ore gave an average of 30 oz. of silver per ton. The lowest individual value obtained from one sample was 8 oz., and the highest was 80 oz. of silver per ton. The vein matter consists of quartz mixed with a small portion of crystallized calcite. The silver occurs largely in the form of argentite, with occasional sprinklings of native silver.

At the time of my visit, in April, a dozen prospectors had pitched their camps at the mouth of Hunter Creek, a mile north of the discovery, and an equal number was coming in as I left. This region, unlike many other places in the desert section of the Southwest, is well supplied with water, and though there is no timber the many deep canyons offer a sympathetic shelter to prospectors against the dry desert heat.



Saline sink and valley, with discovery hill in lower left-hand corner



Distorted limestone on Essex claim. Silverado claim in foreground

Katherine Gold Mines Co. Will Reorganize

At the recent meeting of the stockholders of the Katherine Gold Mines Co., Kingman, Ariz., and the parent company, the New Comstock, it was decided to reorganize the company. This was done under the laws of the State of Delaware. The capitalization has been placed at 2,505,000 shares, 5,000 shares being preferred stock, with a valuation of $100 per share, and the 2,500,000 shares having a value of $1 per share. The preferred stock is to be sold for the purpose of taking up the bonded indebtedness of the old corporation and to provide a fund for development, additions to the milling plant, equipment of camp buildings, and other plant improvements.

Drought Retards Mining in Joplin District

Not for many years has a drought threatened zinc and lead ore production in the Joplin-Miami field as early as it has this year. Continued lack of rain has curtailed the water supply until several mines have already been forced to close, and others will be shut down in the near future. In the late fall of 1924 there was a water shortage and about fifteen properties were forced to close. Not since then has there been any serious difficulty.

Callahan Zinc Will Build 150-Ton Mill

Following a meeting of the directors in Wallace, Idaho, on May 24, D. A. Callahan, president of the Callahan Zinc-Lead Co., announced that the company would proceed at once with the construction of a 150-ton flotation mill for the Galena property, situated about two miles west of Wallace. This property has been under development for the last two years, and the vein has been explored by shaft to a depth of 1,400 ft. and also by drifting and raising on the main tunnel level. The ore is lead-silver.

It is the purpose of the company to carry out further development plans both by sinking and drifting east on the 600 level. A new, heavy-duty electric hoist has been ordered, which will replace the hoist now in service on the

600 level. Sufficient tonnage is developed to supply the mill at capacity, and the profits from production are expected to more than cover the cost of carrying out the extensive plans the company has in view, which will enable the company to complete its extensive development program and conserve the large cash balance in the treasury, and if results prove satisfactory a mill of larger capacity will be built adjacent to the railroad.

New Year's Gift Mine Sold

George Utter, of Long Beach, Calif., has disposed of his holdings in the Carlisle mining district, in Arizona, near the New Mexican line. Among the properties is the famous New Year's Gift group, which produced gold in the early days. The transfer was made to George F. Wilson and Angelo Pavento, of Globe, Ariz., who plan development at once.

Electrolytic Zinc Plant Under Consideration at Kellogg, Idaho

F. W. Bradley, of San Francisco, president of the Bunker Hill & Sullivan Mining & Concentrating Co., is at Kellogg, Idaho. One of the main purposes of his visit at this time is to confer with Stanly A. Easton, general manager, and others of the Bunker Hill & Sullivan staff regarding the construction of an electrolytic zinc plant at Kellogg, which the company has long had under consideration.

Soon after the Bunker Hill & Sullivan company took over the Star mine, in conjunction with the Hecla, President Bradley announced that his company would build an electrolytic plant at a cost of approximately a million dollars to treat the zinc product of the Star and also to provide a local market for zinc ores of Pine Creek. The Star mine is now in a position for steady production and quite a large tonnage of zinc ore is available on Pine Creek. The Star has its own mill at Kellogg, and the Bunker Hill & Sullivan company is now remodeling the Sweeney mill, which will be operated as a custom plant to handle the zinc-lead ores of Pine Creek.

It was officially stated upon Mr. Bradley's arrival at Kellogg that the electrolytic zinc plant would be given full consideration while he was there and that a definite announcement would soon be made covering the plans of the company. The belief prevails that construction of the plant will proceed immediately following the announcement.

Hidden Treasure Reported Sold

It is reported that the National Lead Co. has purchased the Hidden Treasure mine, near Lake City, Hinsdale County, Colo., and that negotiations are under way for acquiring adjoining Ute and Ulay property, recently secured by M. R. Burke, of Denver, through R. E. L. Townsend. The probability is that the Hidden Treasure is merely under option or bond and lease, in view of the possible acquisition of Ute and Ulay.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Kirkland Lake an Outstanding Gold Camp—Outlook for Future Promising

The outstanding gold camp in Ontario at the present time is Kirkland Lake. It is making faster progress than any of the other gold districts and is probably making greater progress than any other gold camp on this continent. It is an outstanding camp, but is overshadowed by its big neighbor—Porcuping. In 1925 gold production amounted to $5,600,000, an increase of approximately 55 per cent over that of the preceding year. Production is now at the rate of $7,000,000 a year and by the end of 1927 should be at the rate of $10,000,000 a year.

At the Kirkland Lake Gold property rich ore has recently been encountered at the 2,100 and 2,225 levels. At the 2,100 level an oreshoot 150 ft. long, averaging approximately $40 a ton over five to six feet, has been exposed. On the 2,225 level 100 ft. of medium-grade ore was opened up, but the present east face is running much higher, the grade being about $70. The company has started overhauling its mill with the expectation of resuming milling operations in the fall.

At the Teck-Hughes, immediately to the east, production is at the rate of approximately $145,000 to $150,000 a month. Developments on the 11th, 12th, and 13th levels of the new south vein have shown ore which is expected to run between $30 and $40 over widths up to 15 or 18 ft. On the 12th and 13th levels these oreshoots have been proven for a length of over 700 ft. At the present time diamond drilling is being done below the 13th level, and though no official statement has been made, results are believed to be satisfactory.

At the Lake Shore, production is now at the rate of 500 tons a day, and this will be increased to between 550 and 600 tons daily. Recovery will be about $16, and costs should be approximately $6. This indicates a production of a little over $3,000,000 a year and profits of about $1,800,000, or 90 per cent of the capital. The company is paying dividends of 40 per cent annually.

At the Wright-Hargreaves property, to the east of the Lake Shore, developments on the 1,250-ft level have exceeded expectations. The north vein not only shows greater width but higher values, and has been opened up for a length of 1,300 ft.

A new hoist will soon be installed on the north shaft. This shaft has been sunk 400 ft. and a winze immediately under it has been sunk from the 700 to the 1,250 level. The winze and shaft will be connected and used for handling men and materials. The mill is handling 450 tons a day and is producing $175,000 to $200,000 a month.

At the Sylvanite property adjoining the Wright-Hargreaves, developments on the 1,000 level in particular have been very encouraging, and it is understood that the company will soon start construction of a mill.

Better results are also being encountered at the Tough-Oakes, where developments to the east of the diabase dike are proving ore of good grade.

Jarbidge District Producing at Rate of $600,000 per Year

PUBLISHED bullion tax returns on mines in Elko County, Nev., covering operations during the last quarter of 1925, show that mines in the Jarbidge district produced 14,419 tons of ore, with a gross value of $151,244, during that period. The Elkoro Mines Co. produced 13,005 tons, which averaged $11.032 per ton, with net proceeds of $45,098.30. The United Eastern Mining Co., which only recently began operations in the Jarbidge district, on the Bluster and Success groups, produced 1,414 tons, which averaged $5.48 per ton, with operating loss of $38,650.40. Values are practically all in gold.

High-Grade Silver Ore Reported Near St. John, N. B.

Considerable importance attaches to a discovery of high-grade silver ore which has been made at Coldbrook, near St. John, N. B., by Harold A. Murphy. A sample of the ore was sent to Ottawa for analysis by the Geological Survey. The sample contained native silver, with which are associated sulphides of copper and iron. An effort is being made to ascertain the size of the deposit.

American Smelting Asks for Review of Carson Case

The American Smelting & Refining Co. has petitioned the United States Supreme Court for a review of the Carson case on new grounds. The brief states that Carson in 1923 transferred the two patents involved to one John Henry Miller, retaining no property interest whatever in them, and that, therefore, Carson cannot be awarded the title.

Federal Developing Property Near Duenweg

The Federal Mining & Smelting Co. has started de-watering the Duenweg field, about four miles east of Joplin, Mo., in the Joplin-Miami district. Drilling options are held on several hundred acres of leases in this section, and prospecting has continued for almost a year. It is understood the plan is to complete the dewatering, then enter old shafts, and drift to promising drill holes.

Eagle-Picher Purchases Martha B Mine

The Eagle-Picher Lead Co. has purchased the Martha B. mine, south of Baxter Springs, Kan., the reported consideration being $65,000. The property includes two adjoining forty-acre tracts, and a small concentrator, and is surrounded by several excellent producers. It was owned principally by R. B. Jensen, of Baxter Springs and Joplin.

London Letter

By W. A. Doman
Special Correspondent

Strike Delayed Publication of Company Reports—Waihi Mine Nearing End

London, May 18—With the general strike over, the city is getting busy again. It can scarcely be said that it is returning to business, for it carried on throughout the trying days. The great trouble was that mining companies experienced difficulty in getting their reports printed; and what is of equal, or more, importance, it was next to impossible to get them distributed, for in the newspaper strike was included the Paper Workers' Union, which deals with the distribution of printed matter. We are now back to normal, and it will be possible for mining companies to issue their progress reports.

The general strike failed, as it was bound to fail, seeing that it was illegal, and at present no one can say what amount of damage has been caused to the trade of the country. Take tin, for instance. The purchasers of the concentrates of the Cornish mines refused to buy more than a certain quantity owing to the fact that large sums of money are required to finance the business, and with so many industries at a standstill there was no demand from manufacturers. As a result at least one Cornish mine had to be closed down.

As regards platinum, the Transvaal Consolidated Land & Exploration Co. reports that during April 845 tons were milled at Onverwacht, for an estimated return of 545 oz. of platinum and allied metals, equal to 12.9 dwt. per ton milled. The metal is being refined in London, and "satisfactory prices" are being obtained. No mention is made as to the cost of production. Good developments are reported in the prospecting shaft, which has been sunk and sampled from 250 ft. to 286 ft. The Transvaal Platinum has not done so well. From 1,200 tons milled only 89 oz. have been recovered. It is hoped to obtain a better recovery during the current month.

A message from Johannesburg states that the new plant at the Government Areas mine is running satisfactorily, and will be in full operation next month.

Owing to the good reef disclosures on the Sub-Nigel, the Brakpan, and Springs Mines, hopes are rising that at last something of value will be found in the vicinity of Boksburg. One company at least in this district—the Rand Nucleus—has remained dormant for many years, and there is talk of reviving its activities.

All great gold mines come to an end, and the remarkable Waihi (New Zealand), noted for the number and width of its lodes, is beginning to show diminished ore reserves. At one time this mine was regarded in some quarters as an investment for the savings of widows and orphans, but no mine merits such an appellation. The management is doing everything possible in the way of lateral exploration in the hope of finding new lodes, but the chairman was not optimistic at the meeting held last week.

Giesche Purchase Concluded by Anaconda-Harriman Group

The Anaconda Copper Mining Co. and W. A. Harriman & Co., bankers, have acquired control of the Polish holdings of George von Giesche's heirs. The negotiations, which have been going on since last November, have just been concluded.

The von Giesche concern controls 10 per cent of the world's zinc production, owns some of the finest coal mines in Germany, besides lead and silver smelting works, brick factories and porcelain works, three quarries, artificial silk and sulphuric acid factories, and holds title to 10,000 acres of agricultural land and 7,000 acres of forest. It also owns a bank.

At the request of the Prussian State Government the Harriman-Anaconda representatives agreed that acquisition of the Polish part of the concern would not mean interference with operations of the von Giesche properties in Germany.

Although the contract between the Polish Government and the Anaconda-Harriman interests regarding the sale of the mining and manufacturing holdings of the George von Geische heirs has not yet been formally signed, the negotiations have been approved in principle by the Polish Government.

Roman Knoll, Polish under-secretary in the Foreign Office, states that the transaction merely awaits the formal installation of a new cabinet before being officially ratified.

Egyptian Oil Fields to Be Exploited

The Société du Naphte has just been formed at Geneva, Switzerland, with a capital of 13,000,000 Swiss francs, for the purpose of exploiting oil fields, chiefly in Egypt, Syria, and Palestine. Mr. Charles Augustus Moser, of New York, is president of the board of directors.

North African Phosphate Syndicate Dissolved

After the Tunisian Phosphate Co. had declared its retirement from the North African Phosphate Syndicate, the other members of the syndicate also declared not to be any longer bound to the regulations. The differences were brought about by decreasing prices for phosphate.

New Metallurgical Course at Harvard

Harvard University now offers a one or two year intensive post-graduate course open to qualifying students who are graduates of recognized colleges and engineering schools and leading to the degree of the metallurgical engineer. The new course, which will be initiated this fall, will provide a one-year program of intensive study in either the metallurgy of iron and steel or in non-ferrous metallurgy.

Johannesburg Letter

By John Watson
Special Correspondent

Transvaal Mining Costs Lowest in Nine Years—New Report On Platinum Deposits

Johannesburg, April 27—The Transvaal Chamber of Mines has issued a monthly analysis of the March gold production, showing that the working costs on the Witwatersrand mines averaged only 18s. 9d., which is the lowest figure for nine years. The working profit for the whole Rand totaled £1,068,546, being at the rate of 8s. 6d. per ton milled, against last year's average of 8s. 9d.

The Union Geological Survey has just received a valuable preliminary report on the platinum deposits in the southeast part of the Rustenburg district, prepared by Dr. Percy A. Wagner. This memoir confirms the account of the promising results of prospecting carried out by the direction of Dr. Merensky. In the Rustenburg area, an almost continuous sheet of black turf soil covers the part of the norite zone in which outcrops of the Merensky reef were to be expected. A large number of prospecting shafts and pits have been put down, and most of these have been systematically sampled; the results have been such that Dr. Wagner considers that there is in this district a possible platinum producing area of the first importance. The platinum horizon has been traced for a distance of about 55 miles, and over a stretch of 30 miles it appears to be continuous. Judging by results so far obtained, Dr. Wagner estimates that there should be no difficulty in maintaining in certain sector a grade of over 4 dwt. per ton.

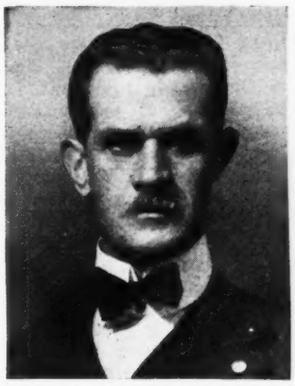
A Promising Bismuth Discovery

A find of bismuth in the Waterburg district, about 40 miles from Warmbaths, is reported. New Pretoria Silver Lead Co., Ltd., has an option to purchase for £5,000 a block of 2,000 claims, on which bismuth ore has been found. Licenses have been paid on these claims up to July 31. The orebody is said to be opening up satisfactorily. Bismuth to the value of £300 was produced in the Union in 1919. A very rich mass of bismuthite (from which several tons were extracted) was found in 1897 on the farm Geweerfontein No. 604, in the Bushveld granite area of the Transvaal. A certain amount of work was done, only a few years ago, on this deposit, but with indefinite results.

Green Diamond Found on Vaal River

A green diamond of 9 carats was found recently near Bloemhof, on the Vaal River, by a digger named Robinson. He was offered from £45 to £60 for the stone, which, however, he sent to Johannesburg to be cut. A flaw was found in the middle, so the stone was cut into two stones of 2 and 1¾ carats, respectively. On cutting, the gem changed color from green to a shade almost amber, and on polishing a suggestion of green flushed back. The gems are now said to be worth £2,000 to £3,000.

People You Should Know About



F. D. Pagliuchi

F. D. Pagliuchi, mining engineer, is in New York on business connected with the gold and iron-ore properties which he has under development in Venezuela. His principals include capitalists in Cuba and the United States.

Fred A. Brinker, mining engineer, of Denver, Colo., is in New York.

W. J. Trethewey, mining engineer, is in the Red Lake gold field.

W. W. Mein, of San Francisco, visited the International Nickel Co.'s plant recently on his way to Europe.

H. W. Turner is examining a drift-gravel channel of Tertiary age in Sierra County, Calif.

R. C. Warriner, New York, president of the Continental Mines, Ltd., of Kirkland Lake, has been in Toronto.

J. E. Spurr has returned to New York from Cincinnati, Ohio, where he attended the coal-operating officials' meeting of the American Mining Congress.

Louis D. Huntoon left Toronto last week to examine properties in the Shining Tree area of Ontario west of Sudbury and south of Porcupine.

Dr. A. L. Hall, of the South African Union Geological Survey, represented the Union Government at the International Geological Congress held in Madrid.

H. D. Budelman, mine superintendent for the West End Consolidated Mining Co. at Tonopah, Nev., has returned to Tonopah from a trip to southern California points.

W. M. Archibald, of the Consolidated Mining & Smelting Co., is examining properties in the Red Lake district of northern Ontario in the interests of his company.

James W. Wade, assistant general manager for the Tintic Standard Mining Co., of Utah, has been in Washington and New York on business for the company.

William E. Thorn has returned to his home at Santa Rosa, Calif., from London, to which point he returned after examining alluvial gold deposits in Northern Rhodesia, Africa.

Pope Yateman was recently at the International Nickel Co.'s Sudbury plant, where he was in consultation with the officials regarding the proposed new shafts at the No. 3 mine.

John Reinmiller, who is manager of the Ramsey Comstock mine, near Reno, Nev., and president of the newly formed Reno Stock Exchange, has returned to Reno from a business trip to Los Angeles.

J. B. Tyrrell, of Toronto, has severed his connection with the Anglo-French Mines, but will continue to be associated with the Kirkland Lake Gold Mines, his contract with the latter having three more years to run.

Dr. William Cullen, of London, chairman of the Climax Rock Drill Co., who was well known in Johannesburg when manager of the Modderfontein dynamite factory, arrived recently in Johannesburg after an absence of about eleven years.

J. H. Hearding, of Duluth, assistant general manager of the Oliver Iron Mining Co., delivered the address at the commencement exercises of the graduating class of the Michigan College of Mines. There were thirty-eight members in the class.

Obituary

Joseph Crocker Sibley, former chairman of the board of directors of the Galena Signal Oil Co., and widely known oil man, died recently at his home near Franklin, Pa.

John McKay Thorburn died recently at Johannesburg, South Africa, in his forty-fourth year. Mr. Thorburn was latterly engaged as analytical chemist on the State Mines (Government Areas); previously he was on Randfontein and formerly assistant with the late Alex. Heymann. He leaves a widow and two young children, to whom a message of sympathy was accorded by the last meeting of the Chemical, Metallurgical and Mining Society.

Professor D. B. Waters, of the Otago (New Zealand) University School of Mines, died recently at the age of fifty-four. He graduated from the school in 1890, and for seven years was engaged in mining and metallurgical work. In 1900 he was appointed lecturer in metallurgy and assaying at the school of mines and was for a time acting director. Subsequently he was appointed professor in association with the director, Professor James Park. During the war he was a captain in the New Zealand Tunneling Co., and one of his great works was the subterranean tunneling at Arras. He had been in poor health for the last twelve months.

George F. Bridger, mining engineer, died recently in Mexico City. He was a native of California and had been a resident of Mexico for the last twenty-five years, having been associated with many mining enterprises in the southern republic, particularly in Guanajuato, Real del Monte, Pachuca, and in Jalisco, with headquarters in Mexico City. He was a member of the American Club and a veteran of Spanish-American War. Mr. Bridger left a large circle of friends in Mexico. The immediate family surviving are A. J. Bridger, Thomas J. Bridger, brothers, of Los Angeles; Mrs. Jameson Cotting and Mrs. Constance Sloan, of New York City, sisters.

Price McKinney

Price McKinney, whose death was recently announced, ranked high in the steel industry, but he was not as widely known as are many others. He did not seek publicity. He escaped it for himself and his company because he did not consider it an essential part of his business. He was a leader, an organizer, and executive of high order. His was the dominating influence that made the McKinney Steel Co., Cleveland, Ohio, one of the most successful of the independent steel firms. Few, even among his compeers, were able to visualize the full measure of his accomplishments. A vacillating mind was none of his. Mr. McKinney was very positive in every move he made. His decisions were usually correct, and, once decided, seldom did he change. This is illustrated in an instance when he was walking along the street and was accosted by a rival steel manufacturer, who paused to ask him a question. "Come over here," said Mr. McKinney. When they met and were out of the crowded thoroughfare Mr. McKinney said, "You may catch me on this side of the road or on that side of the road, but you will never catch me in the middle of any road." He was generous, but courted no favors. His employees were liberally remembered at Christmas time, often to the extent of 50 to 100 per cent of a year's salary. He was quiet, unassuming, a good conversationalist, a lover of dogs and horses, and was the owner of a number of prize animals. Mr. McKinney's death leaves a place in the mining and steel industries that will be difficult to fill, for it was his personality and keen insight that built up an independent and self-contained business unit, operating its own iron mines, coal mines, blast furnaces, steel furnaces, and fabricating plant.

Price McKinney

Societies, Addresses, and Reports

Mining Congress Discusses Stream Pollution

One of Many Subjects Considered at Cincinnati Convention

By R. Dawson Hall
Engineering Editor, *Coal Age*

ACTING on the information from J. F. Callbreath, secretary of the American Mining Congress, that in Idaho the lead-mining companies had been required to purify the water leaving their property so that the streams would be as pure as above the plants, the American Mining Congress' Convention of Coal-Operating Officials, held on May 25, in Cincinnati, Ohio, appointed H. N. Eavenson, consulting mining engineer, of Pittsburgh; H. I. Young, general manager, American Zinc Co., of Mascot, Tenn., and J. J. Rutledge, chief mining engineer, State of Maryland, as a committee to investigate the subject and recommend what action should be taken.

H. I. Young reported that suit had been brought to require his company to give its effluent water additional treatment that would prevent the discoloration of the water delivered to the stream. He said that the water which the company was putting in the stream in no way polluted it.

William L. Stevenson, chief engineer, Sanitary Water Board of Pennsylvania, addressed the convention on the "Restriction of Stream Pollution." Mr. Stevenson said the mining industry should be willing to enter into a co-operative investigation to ascertain what can be done to keep the streams reasonably free from pollution. The tannery interests and those of the paper and pulp industry have arranged for studies, the latter with the state authorities. The tanneries have appointed three chief engineers and three chief chemists of the tanning companies, on a committee with Mr. Stevenson as chairman.

This committee will direct laboratory research, the actual operation of a full-scale experimental tannery-waste treatment works, and will make observations of the streams below the works to determine the assimilating power of the stream to receive untreated waste, and also the effluent of the treatment works with various degrees of purification.

It would not be well, according to Mr. Stevenson, for the mining industry to show indifference to the demands of the public and thus invite crippling legislation, nor should the public work against its own interest by passing unreasonable laws that would destroy industries upon which its own prosperity depends. Mr. Stevenson would divide the streams into three classes—namely, those in a pristine condition, which should be preserved from pollution; those which are more or less polluted, where pollution should be controlled; and those already so greatly polluted that they should be regarded as natural sewers.

The session in which mine drainage was discussed was the first of eight meetings which took place May 25-28 inclusive in the Music Hall, Cincinnati, Ohio. Other sessions were on the cutting and blasting of coal, mechanical loaders, underground conveyors, accident prevention, roof control, mining methods, and underground transportation. In connection with the meeting was held May 24-28 an exposition of coal-mining machinery, the exhibits of loading machines and conveyors being particularly notable. Thirty engineers presented addresses and at least as many others presented prepared discussions. There were ninety-two exhibitors in the exposition. An unusually large number of persons attended the sessions and listened to the addresses and discussions presented. Much of the equipment was of a character well suited to the operation of metal mines, especially those working level beds.

James S. Douglas Decries Efforts to Put Tariff on Copper

In a recent address before the Douglas (Ariz.) Kiwanis Club, J. S. Douglas, president of the United Verde Extension Mining Co., stated that the leaders of the copper industry are not in favor of the tariff, but consider it would be a detriment to the industry.

"There are many arguments against the proposed copper tariff and none for it," said Mr. Douglas. He further stated that the copper industry was "managed by experienced business men, who are better able than any meddling politicians to know the needs of that industry and consequently any demand for a tariff on copper should come from the leaders of the industry and not from politicians."

The proper remedy for the recent slump in the copper industry, Mr. Douglas asserted, is not a tariff, but the creation of a new market for copper products and new uses for the metal itself. He expressed the opinion that the enactment of a 6c. tariff would invoke foreign nations to retaliate with a like measure, which would be harmful to American industry.

Gillan Heads Southern California Section

At the annual meeting of the Southern California Section of the A.I.M.E. held May 11 the election of officers for the coming year resulted as follows: Chairman, S. L. Gillan; vice-chairman, H. S. Mudd; secretary-treasurer, G. D. Robertson; additional members of executive committee, Joseph Jensen, W. C. Browning, John E. Hodge, and W. W. Copp.

Millions of People Concerned in Perpetuation of Iron Mining

Hotchkiss Gives Figures Showing Importance of Lake Superior Iron-Ore Industry—Low-Grade Deposits

W. O. Hotchkiss, president of the Michigan College of Mines, at Houghton, Mich., at the iron-ore session of Chemical Equipment and Machinery Week at Cleveland, Ohio, stated that at the present rate of production—without allowance for any increased demand—known reserves of merchantable grades of iron ore in the Lake Superior region will be exhausted in approximately twenty years. Those of Michigan will be exhausted in a considerably shorter time, he said.

"This statement is optimistic rather than otherwise," declared Dr. Hotchkiss. "The demand for Lake Superior iron ore is not going to remain stationary for the next twenty years. Population will increase and the per-capita consumption will also increase.

Distribution of Iron Consumption

"The average person when told the facts is likely to think with some compassion, 'Well, that will be hard on the miners of Michigan and Minnesota.' But is that all? In Ohio, 225,000 persons were employed in industries making iron and steel products from Lake Superior ore, and $900,000,000 of capital was invested in these industries, according to the last census. Over a million men, women, and children in Ohio alone are dependent for their livelihood on the industries based on Lake Superior iron ore.

"In the northern Mississippi valley states, more than 1,750,000 persons are employed in making Lake Superior iron ore into consumable articles, and they and their dependents number well over 8,000,000 perons. In addition to these directly dependent are all the others who serve their wants, merchants, laborers, transportation workers, and all the other workers in occupations too numerous to mention. Over half of the nineteen billion dollars of industrial capital in these states is invested in industries based on iron and steel.

"So the dry statistical statement that present merchantable grades of iron ore in the Lake Superior district will be exhausted in about twenty years becomes invested with a lively interest to a vast group of people.

Huge Reserve of Low-grade Ore

"In addition to the twenty years' supply of high-grade iron ore in the Lake Superior district, there are low grades sufficient to last for centuries if ways can be found to treat them so they can be used in the blast furnaces. At present no processes for this ore are known that can compete with the high-grade ores now available. Herein lies the reason for the states of Michigan and Minnesota interesting themselves in the working out of such processes. Minnesota already has spent nearly $1,000,000 on this work, and Michigan is making plans to get busy. The other states—Ohio, Pennsylvania, Indiana, Illinois, and Wisconsin—are more than mere interested spectators."

Recent Technical Publications

Reviews, Abstracts, and References

Occurrence of Platinum Minerals in South Africa

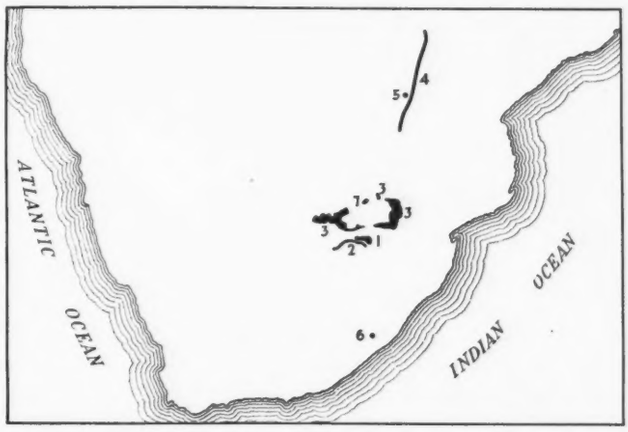
A REVIEW BY J. E. SPURR

THE RECENT PLATINUM AREA opened in South Africa is by all means the most astonishing mineral discovery for several years, and *Engineering and Mining Journal-Press* has accordingly followed the developments closely, both in the news and in specially contributed articles. The geology of the region is being competently worked out by Dr. Percy A. Wagner, of the Geological Survey of South Africa. The second of two articles on this subject has just appeared in *Economic Geology* (Vol. 21, 1926, Nos. 2 and 3).

The platinum belt so far discovered runs northward from the Transvaal into Rhodesia and southward into the Cape of Good Hope region, through some 15 degrees of latitude, a distance of nearly 1,000 miles. Aside from the alluvial occurrences, the lode deposits occur in connection with intrusive and extrusive igneous rocks of several distinct ages, ranging from the Pre-Cambrian to the Cretaceous; but in all these stages the igneous rocks are essentially of basic or ultra-basic types. Platinum minerals, probably of detrital origin, have even been found throughout the Rand gold-bearing conglomerates. The basic platinum-bearing igneous rocks, which are of the peridotite and gabbro families, represent a large variety, with appropriate special and often unfamiliar names; norite (a kind of gabbro) is one of the most conspicuous varieties and this name furnishes a general designation for the whole basic magma (noritic magma). The ores are in some places associated with chromite, and in others with magmatic nickel-copper-iron sulphides; and in these respects have the familiar rock-magma and ore-magma affiliations of platinum the world over. An interesting conclusion of Dr. Wagner is that the dunite (olivene-chromite rock), in which in some regions the platinum occurs as a primary constituent, may be of pegmatitic nature, a conclusion which is in line with the reviewer's expressed conception of ore deposits, even the magmatic ore deposits of basic rocks. Platinum ores in some of these South African districts occur not only within the igneous rock but as a replacement of intruded rocks, especially dolomite. Platinum also occurs in the acid differentiates from the noritic magmas: thus the metal occurs in a quartz-feldspar-biotite pegmatite, and even in a quartz vein or veindike: and, too, in very important economic quantities in a series of great brecciated quartz lodes in the Waterberg district, where the platinum has a quartz-chalcedony gangue and is associated with specularite and with chromiferous chlorite. These lodes are high-temperature deposits formed close to the surface, and Dr. Wagner believes that the siliceous solutions which formed them may have been ultimately derived from a basic or ultra-basic magma.

Under the head of "General Genetic Considerations," the conclusions of Dr. Wagner are so significant as to be worthy of quoting in full:

"It will be evident from what has gone before that the metals of the platinum group are unusually abundant in South Africa. In no other part of the world, so far as the writer is aware, are they so widely distributed, and no other country certainly can show such concentrations in the mother rock. It is evident also that platinum-bearing rocks have been represented in practically all of the periods of igneous activity in the long geological history of the sub-continent, even going back to the earliest Archæan.



Map of South Africa, showing location of principal occurrences and potential sources of the platinum metals.
1. The Witwatersrand gold field.
2. The Black Reef.
3. The Norite zone of the Bushveld Igneous Complex.
4. The Great Dike of Southern Rhodesia.
5. The Somabula fields.
6. Deposits of the Insizwa Range.
7. The deposits of the Waterberg district.

"The widespread occurrence of the platinum metals is thus clearly due to some deeply underlying cause that has operated continuously through geological time. In endeavoring to seek this cause, it will be necessary first of all to consider briefly the probable structure of the outer part of the earth.

"There is a fair consensus of opinion among geologists that this consists of concentric shells of rock of gradually increasing density. There is also very strong evidence to support the view of Daly (see "Igneous Rocks and Their Origin," pp. 164-166; also Joly, J., "Radioactivity and the Earth's Crust," being the Halley Lecture delivered on May 28, 1924, Oxford University Press, and other publications by the same author) that the continental or *sial* crust and the ocean basins are underlain by a universal shell of basaltic composition. From what is known of the process of crystallization of basic igneous rocks there is every reason to suppose (see Adams, L. H., *Jour. Wash. Acad. Sci.*, Dec. 4, 1924) that this shell merges downward into a shell of peridotite—the *sima* zone of Suess (see "The Face of the Earth," Vol. IV, p. 544), which either underlies or, as appears more probable, includes the eclogite shell of Goldschmidt ("Der Stoffwechsel Der Erde," *Vid. Skrif. I. Mat.-Naturv. Klasse*, Kristiania, 1922, No. 11).

"Most geologists are also in agreement with Suess's view (note same publication) that the *sima* zone is the original home of the platinum metals found in the portion of the earth's crust accessible to our observation.

"Granting that the hypotheses here briefly outlined are correct, then the unusual abundance of platinum metals in the igneous rocks of South Africa could easily be explained on the assumption that the portion of the *sima* zone underlying the sub-continent is abnormally rich in platinum. Even if this should be so it would still be necessary, however, to account for the linear arrangement of the principal deposits described in the preceding pages. . . . Despite their being so widely separated in age, these are all confined to a more or less meridional belt lying between longitude E. 26 deg. and longitude E. 30 deg. 40 min.; while the occurrences of the Insizwa and Lydenburg areas and those of the Great Dike of Southern Rhodesia lie between longitude E. 29 deg. 20 min. and longitude E. 30 deg. 40 min. It is clear that there is here a great *platinum belt* that cuts indiscriminately across the oldest and youngest geological formations, completely disregarding geological structures and the structure lines in the more superficial parts of the earth's crust.

"To J. E. Spurr we owe the conception of the great *ore canals* of this nature, stable throughout geological time, along which the most important mineral deposits of the world are situated, and which pursue their way across continents regardless of rock formations and of the folding and faulting in them; their position being thus evidently determined by structural features in the portion of the earth's crust underlying that exposed to our view by denudation. (J. E. Spurr: "The Ore Magmas," Chap. XI). Spurr's idea is that when one of these ore canals taps a portion of a sub-crustal layer particularly rich, let us say in copper, the igneous rocks along the line of the ore canal will be abnormally rich in copper, and so with silver and other metals.

"Again accepting the correctness of this hypothesis we may conceive the presence below the eastern part of the South African shield of a great platinum canal, that, from the earliest geological times, facilitated the upward transference of the metals of the platinum group from an especially platinum-rich portion of the *sima* zone into the rocks forming the continental crust. (Incidentally it may be remarked that, as the platinum belt includes the greater

part of the remarkable Southeast African gold province, responsible at the present time for over 55 per cent of the world's annual production of that metal, and gold is not infrequently associated with platinum in the primary occurrences, the gold probably came up along the same canal as the platinum and along one paralleling it on the east.)

"It would appear, therefore, that the portion of the *sima* zone underlying the southern part of Africa is abnormally rich in the platinum metals, and that there exists beneath the eastern part of the South African shield a great ore canal that throughout the geological ages has facilitated the upward transference of these metals. Further platinum discoveries are to be expected along the course of the canal."

Mexican Mining Directory—*The Mexican Magazine*, Apartado Postal 2,919, Mexico, D. F., has issued a valuable directory of the mining companies in Mexico that are now producing. The list does not include prospects or old mines on which no work has recently been done, nor inactive mines on which taxes are being paid, but is intended to include only those properties that are supposedly in the market for supplies. The names of executive and operating officials are given in practically every instance, together with much other information on the capital, ownership, minerals produced, capacity, situation of head office, mine and mill, and method of treatment. The information, though brief, is in convenient form for reference, and is in English. A translation of all amendments to the mining law of Jan. 1, 1910, by R. G. Hardy, is also included. The price of the book is 5 Mexican pesos.

Leadville, Colo. — U. S. Geological Survey Bulletin 779, by G. F. Loughlin, is entitled "Guides to Ore in the Leadville District," pp. 37, with a map of the orebodies in the district and an index to shafts and tunnels. The bulletin is of a most practical nature, and cannot help but be useful to all operators in the district. The new report of the geology and ore deposits of the Leadville district has been sifted for data of particular interest to the ore-hunting geologist; the more complete report will be issued later. Copies of Bulletin 779 are available for 35c. each from the Superintendent of Documents, Washington, D. C.

South Dakota—Bulletin No. 14 of the South Dakota School of Mines, Rapid City, S. D., is descriptive of "The Geology, Mineralogy, and Scenic Features of Custer State Park, South Dakota." This park is in the heart of the Black Hills and is a most attractive place to visit. Motorists from Chicago to the Yellowstone Park will find it a good stopping-off place, with the famous Homestake Mine near by. Many rare minerals are found in this region. Rushmore Mountain is within the park area, this being the place where Gutzon Borglum, the sculptor, plans to carve heroic figures of American statesmen. About half of the bulletin is made up of photographs and maps, and altogether it makes an excellent guide to this district, for either the mining engineer or the layman. It is presumably obtainable on request.

Economic Geology—*Economic Geology* for March-April (Lancaster, Pa.; price 75c.) contains the following papers: "Occurrence of the Platinum Metals in South Africa; Part 1." by Percy A. Wagner, pp. 26; "Replacement in the Tin-bearing Veins of Caracoles, Bolivia," by Waldemar Lindgren, pp. 10; "Variation of Temperature with Geologic Structure, California and Wyoming Oil Districts," by C. E. Van Orstrand, pp. 21; "Molecular Migration and Mineral Transformation," by A. Wandke, pp. 6; and "California Gold Production," J. M. Hill, pp. 8. There is also a discussion of the Camp Bird Compound Veindike by H. C. Boydell.

The May issue of *Economic Geology* contains the following: "Magmas and Igneous Ore Deposits: Part 1," by J. H. L. Vogt, pp. 27; "Geochemical Relations Between Petroleum, Silica, and Water," by P. G. Nutting, pp. 9; "Occurrence of Platinum Metals in South Africa: Part 2," by P. A. Wagner, pp. 28; "The Britannia Mines, British Columbia," by S. J. Schofield, pp. 14; and "A Gold-Cobaltite Lodestone Deposit, British Columbia," by W. L. Uglow and F. F. Osborne, pp. 9.

Minerals of Idaho—Bulletin 131 of U. S. National Museum is a comprehensive monograph on "The Minerals of Idaho," covering 483 pages. It is the work of Earl V. Shannon, Assistant Curator of Geology of the Museum, and is based principally upon the specimens of Idaho ores and minerals that are in the custody of that organization, with original observations and a complete compilation of the literature pertaining to the mineralogy of the state. The report should be of interest to all mineralogists. Copies are obtainable for 75c. each from the Superintendent of Documents, Washington, D. C. It is regrettable that the pages have been left uncut after binding.

New Zealand Geology—Bulletin No. 27 of the Geological Survey of New Zealand, by H. T. Ferrar and others, discusses "The Geology of the Whangarei-Bay of Islands Subdivision, Kaipara Division," pp. 134. It is obtainable for 15s. from the Government Printer, Wellington, New Zealand. The bulletin describes the geology of an area of 1,095 square miles in North Auckland, and deals fully with the coal, limestone, clay, and other mineral deposits. Several colored maps are included.

Minnesota Mining—The University of Minnesota has recently issued a mining directory of Minnesota for 1926, compiled by John J. Craig. Part 1 consists of maps showing the name and location of all operating and exhausted mines, reserves, and prospects; Part 2 is a list of all the mines and prospects, with situation, recent shipments, and name of controlling interest; Part 3 is a list of operating and holding companies, with the names of officials and the properties that they control; Part 4 is largely statistical matter; and Part 5 is a list of the principal men associated with the mining industry of the state. Copies are obtainable from the Mines Experiment Station, University of Minnesota, Minneapolis, Minn., presumably on request.

Antimony Smelting—F. Borner, in *Metall und Erz* (Vol. 22, pp. 559-564), abstracted in *British Chemical Abstracts*, discusses a method for preparing antimony regulus. A mixture of antimony ore and iron is roasted, sodium chloride or carbonate being added to make the slag (ferrous sulphide) liquid. By further treatment, with addition of antimony sulphide, the iron is removed from the crude antimony. The author gives full details of the process and of the analysis of the metal and slag.

The Argonaut Fire—The story of the Argonaut mine fire, which cost the lives of 47 miners in the summer of 1922, is told in Technical Paper 363 of the U. S. Bureau of Mines, pp. 39, entitled "Lessons from the Fire in the Argonaut Mine." It is by B. O. Pickard. The description of the fire and the efforts to rescue the men is vivid, and is followed by an excellent critical discussion of the unfortunate affair. Copies are obtainable for 15c. each from the Superintendent of Documents, Washington, D. C.

Georgia Clay — "Beneficiation and Utilization of Georgia Clays" is the title of U. S. Bureau of Mines Bulletin 252, by R. T. Stull and G. A. Bole, pp. 72. The report is divided into six parts: (1) Occurrence of clays in Georgia and the source of the clays tested; (2) washing tests; (3) physical tests; (4) utilization of kaolins in white ware; (5) utilization of clays in refractories; and (6) utilization of clays in face brick. The bulletin contains much of general interest and also develops the fact that Georgia clays are susceptible to much greater industrial development than has so far taken place. Copies are obtainable from the Superintendent of Documents, Washington, D. C. for 20c.

Cottrell Treaters and Radio—In the April issue of *Chemical and Metallurgical Engineering* (New York; price 35c.) J. J. Jakosky has a six-page article entitled "Correction of Radio Interference from Cottrell Precipitators." This interference may be entirely eliminated by a method developed by the patent-exploiting companies, which is described in this article.

Transport in South Africa—F. H. Dutton discusses "Road and Rail Transport Problems in South Africa" in the March issue of *The Journal* of the South African Institution of Engineers (Johannesburg; price 2s.), pp. 18. He describes the conditions that must be met and discusses the relative practicability of animal, gasoline, and steam haulage, with costs.

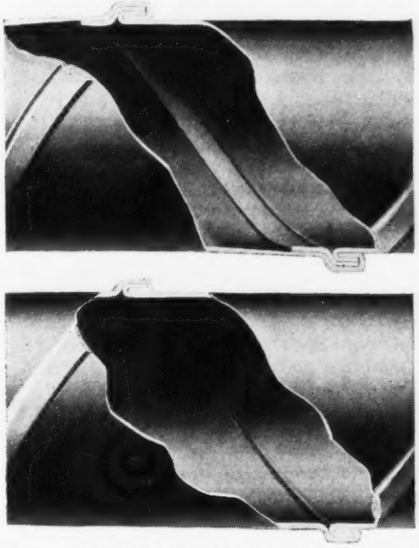
Oil in Colorado and Utah—The U. S. Geological Survey, Washington, D. C., in a memorandum for the press issued in March and obtainable on request, discusses the "Possibility of Finding Oil in Southeastern Utah and Southwestern Colorado." Production of oil from a well on the Cane Creek dome, near Moab, Utah, suggests the advisability of drilling in the various other adjacent districts here described.

Deep-Hole Drilling — "Exploratory Deep-Hole Drilling" is the title of a two-page article in *Compressed Air Magazine* for April, by R. K. Brown, of the Tonopah Belmont Development Co., describing work done with drifter machines by that company.

New Machinery and Inventions

Spiral Pipe Has a Flanged Lock Seam Instead of Rivets

Spiral rivetless pipe is a new product developed by the Naylor Spiral Pipe Co., 1230 E. 92d St., Chicago. No rivets are used in the pipe, the spiral seams



Top — Sketch showing construction of pipe for abrasive materials. Bottom —Pipe for water, air and gas

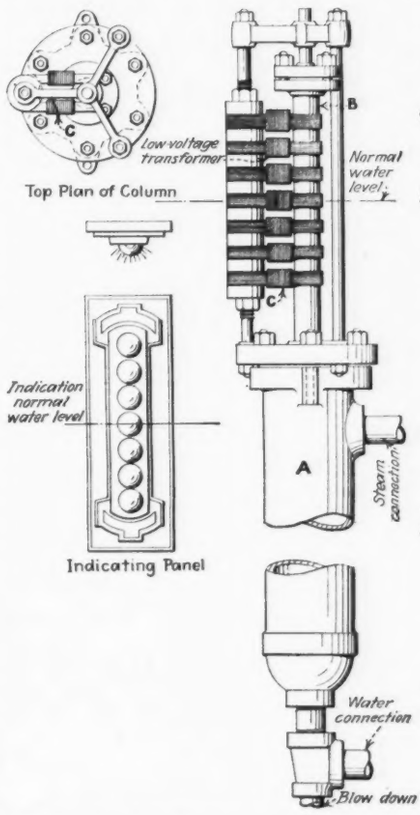
being formed by interlocking flanges. The machines on which the pipe is formed were designed and patented by Carl G. Naylor, president of the company. A strip of sheet metal is wound into spiral shape, the edges automatically flanged and formed into either a 4- or 5-ply lock-seam laid up on the outside of the pipe. Thus the pipe has a smooth bore and is also declared to be especially strong and of light weight. The pipe is formed in a continuous piece and then cut in any desired length up to 40 ft. It is made from No. 16 to No. 10 gage sheets and from 4 in. to 30 in. in diameter. Plain, galvanized, painted and asphalted spiral pipe is available to meet varying requirements.

New Water-Level Indicator

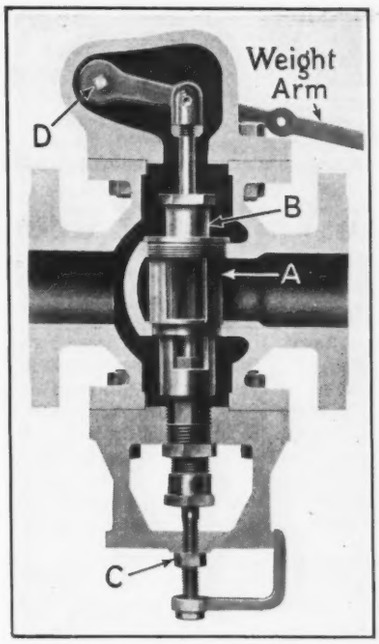
A type of liquid water-level indicator used for boilers, tanks, etc., known as the "Ace," with which one or more indicating panels may be used and which may be placed adjacent to or at any convenient point some distance from the boiler, has been brought out by the W. B. Connor Co., Inc., 110 West 42d St., New York City.

The indicator consists essentially of a float chamber or column *A* with a special extension tube *B* for the armature, low-voltage transformers *C* and a seven-light indicating panel. The tube *B* is made of non-magnetic metal through which the magnetic flux passes across the pole of the external armature. The low-voltage transformers *C* are located outside the apparatus in order to avoid contact with the live steam. They are also not subjected to any pressure or temperature. The armature actuated by a float in the column *A* and responding to the water level, travels through the magnetic field of seven transformers, giving seven indicating points. The armature is tubular in construction, made of magnetic material and copper plated. The rod connecting the armature to the float is Monel metal. The float is kept as small as possible, namely 3½ in. in diameter, and is made of forged steel suitable for steam pressures up to 600 lb. No guides or other internal mechanisms that would tend to cause sticking are used.

The transformers, located as they are, are not subject to excessive temperatures and the voltage carried on the primary is between 3 and 4 volts. The output of the secondary transformer when the armature is out of the field is about ¾ volt and with the armature in the field about 3 volts, operating a 3.8 volt light. The device can be used in connection with operating a series of lights of an indicator as illustrated or a graphic chart for permanent record or a high- and low-water alarm signal. The indicators are made for standard pressures of 150, 250, 400 and 600 lb., and the weight is approximately 175 lb. The water column or float chamber of the indicator can be used as an auxiliary to the standard water column as illustrated, or it can be furnished equipped with water gage to replace the existing column.



Water-level indicator employing low-voltage transformers and a series of indicating lamps



Improved control valve

B.I.A. Control Valve With Adjustable Ports

The illustration shows the improved control valve recently developed by the Northern Equipment Co. for use with the Copes feed-water regulator. The valve is designed to allow changes in the flow area through the valve over a wide range. This adjustment permits compensation to be made in the flow area for any increase or decrease in feed-line pressure and also permits of close regulation on small flows. The changes can be made with the valve in operation.

The valve differs from the control valve usually furnished, in that the seat rings are replaced with the sleeve *A* having rectangular ports, which is screwed into the body in place of the seats. The valve plunger *B*, which moves inside the sleeve *A*, also has rectangular ports of corresponding size. The changes in the flow area are made by rotating the plunger *B* in relation to the sleeve *A* so that the port area is increased or decreased.

The rotation of the valve is made by means of a lever attached to the lower spindle, which has a square recess in its top end to receive the extension on the valve plunger *B*. When the valve has been adjusted for the port area desired, the spindle is locked in place by the locknut *C*.

The valve is also equipped with a through shaft *D* fitted with double stuffing boxes. This feature tends to eliminate any unbalanced thrust on the lever shaft *D* due to high pressure.

The new valve is suitable for pressure up to 1,200 pounds.

Fifty Years of Wire Rope

The golden jubilee of the Broderick & Bascom Rope Co., of St. Louis, Mo., has been commemorated by the company through the issuing of a special anniversary number of "The Yellow Strand," the company's house organ.

The Market Report

Fair Volume of Metal Sold in Holiday Week

Copper and Lead Prices Practically Unchanged—Zinc Approaches 7c.

New York, June 2, 1926—Considering the Memorial Day holiday on Monday, and what practically amounted to a holiday on Saturday also, the volume of metal sold in the week ending today has been very satisfactory and well up to the level of the week before. Prices show little change, copper and lead being almost exactly the same as last week, zinc advancing slightly owing to rumors of restricted production, and prompt tin easing off a bit with increased supplies available.

Copper at 13.825c., Delivered

One interest sold a moderate tonnage of copper at 13⅜c., delivered at usual Eastern points, about a week ago, but then advanced its price to the level generally asked by others, 13.80@13.825c. The higher figure has been that at which most of the business has been done since Friday. Sales for the week have been about equal in volume to those of last week, in spite of the holiday, last Thursday and Friday being reasonably active. There has been little inquiry from the Middle West, however, and sellers were apparently not willing to shade 14c., with the higher freight rates coming into effect soon. Most of the copper sold was for June shipment, indicating that consumers are even more negligent now than before in providing for their future requirements. A little interest was exhibited in July, but August and later months were largely neglected. The brass business continues somewhat quieter than in the spring, but rolled copper is active. Foreign demand has been comparatively light, with business yesterday at 13.95@14c., c.i.f., and about 13.70c., f.a.s.

Zinc Goes Up to 6.95c.

A fair amount of zinc has been sold in the week ending today, a good part of it before the holiday; in fact, the daily rate of sales has been better than last week. As ore prices have shown no tendency to decline recently, and the profit to the smelters has been small at recent levels for zinc, there has been a tendency to raise prices back up to the 7c. level, though that price has not actually been reached as yet. Production is likely to be curtailed at the mines also, as the mines without lead are operating with little or no profit; this, of course, helps to strengthen the market.

Average Metal Prices for May, 1926

Copper:	
New York Electrolytic	13.599
London Standard Spot	56.494
London Electrolytic Spot	64.313
Lead:	
New York	7.751
St. Louis	7.538
London Spot	28.253
London Forward	28.731
Silver:	
New York	65.075
London	30.125
Sterling exchange	485.485
Zinc:	
St. Louis	6.821
London Spot	32.038
London Forward	32.413
Tin:	
99 per cent.	60.165
Straits	62.305
London	270.125
Quicksilver	91.365
Antimony	12.170
Platinum:	
Refined	108.960
Crude	102.900
Aluminum, 98 per cent.	27.000

Daily Prices of Metals

May June	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
27	13.50@13.55	58.25	60.75	7.65	7.45	6.85@6.90
28	13.55@13.575	58.50	61.125	7.65	7.45	6.85@6.90
29	13.575	58.50	61.125	7.65	7.45	6.85@6.90
31	Holiday	.....	.....	.....	....	.....
1	13.575	58.00	60.25	7.675	7.45	6.95
2	13.575	57.25	59.75	7.65	7.45@7.475	6.95
Av.	13.563	58.100	60.600	7.655	7.453	6.905

The prices correspond to the following quotations for copper delivered: May 27th, 13.75@13.80c.; 28th, 13.80@13.825c.; 29th, June 1st, 2d, 13.825c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May June	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
27	56⅛	57	64	267¾	267¾	28½	28 15/16	31⅞	32⅜
28	56¼	57⅛	64	268½	267½	28⅝	28 15/16	32	32 7/16
31	56¼	57⅛	64	267	265½	29	29¼	32	32 7/16
1	56¼	57⅛	64	266	264½	29 3/16	29½	32 3/16	32 11/16
2	56¼	57⅛	64	262¾	261¾	29½	29 11/16	32 5/16	32¾

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

May	Sterling Exchange "Checks"	Silver		Gold London	May June	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
27	4.85⅞	65	30 1/16	84s11½d	31	Holiday	...	30 1/16	84s11½d
28	4.85⅞	65	30 1/16	84s11½d	1	4.85⅞	65	30 1/16	84s11½d
29	4.86	65	30 1/16	.....	2	4.85⅞	65⅛	30⅛	84s11½d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

Spot zinc has been somewhat lower priced than June, though the differential cannot be said to be more than 2½ to 5 points. Zinc in New York is at the customary premium of 35c. per 100 lb. over St. Louis, and high-grade zinc is 8@8¼c. delivered in the East.

Lead Outlook Brighter

Although there is little change in quotations, the tone of the lead market is distinctly better today than a week ago. Whereas the tendency was to shade the prevailing figures of 7.65c. and 7.45c. in the New York and St. Louis markets respectively, small premiums over these prices have been obtained on some sales yesterday and today. The American Smelting & Refining Co. continues its official contract price in New York at 7.65c. A moderate improvement in London has affected sentiment on this side, and buyers who have been holding off appear to be ready to supply their requirements at least for the month of June. One producer seems to have obtained the lion's share of the business, but the total volume has been well up to the average. Sales to storage-battery manufacturers during the week are significant because of the fact that they have been largely out of the market for the last month. In London the increase in the price for spot has been greater than that for future metal, the contango being narrowed to 3s. 9d., against about 12s. several weeks ago. Shipments from Australia during May were materially curtailed; this, together with the warehousing of considerable tonnages which the owners hesitate to withdraw immediately, has been responsible for the better prices for spot. The demand is coming from the Continent, however, rather than from Britain itself. Some speculative buying may also be an element of strength.

Tin Prices Easier

Until today spot tin has been very scarce and has commanded a premium of about ½c. over the prompt prices for Straits which we quote. Several boats now at dock or soon to arrive have eased the situation, however. The statistics for May showed an increase of 2,529 tons in the visible world supply, but this apparently had been largely discounted. The increase is accounted for principally by a decline of about 1,500 tons in deliveries to consumers in the United States. Further continuation of the British coal strike is regarded by many as a bullish factor in tin. Reports are that industries are being rationed with coal in Britain, but as the producers as well as consumers presumably will curtail, the effect will be a net decrease in supplies of metal, because more tin is smelted than is consumed.

Silver Quiet and Steady

The silver market continues quiet and steady, with the chief support coming from the Indian bazaars. Fluctuations both here and abroad have been extremely narrow, and no factors indicating a material change are apparent.

Mexican Dollars: (Old Mexican pesos) May 27th, 28th, 29th, 49⅜c.; 31st, holiday; June 1st, 49⅜c.; 2d, 49⅞c.

Improvement in Francs Continues

Apparently the attempts to bolster up the franc are meeting with at least temporary success, as the exchange rate has advanced materially. Closing cable quotations on Tuesday, June 1, were: francs, 3.30c.; lire, 3.815c.; and marks 28.31c. Canadian dollars are at ⅜ per cent premium.

Zinc Blende and Lead Ore Prices Unchanged

Joplin, Mo., May 29, 1926

Zinc Blende	Per Ton
High	$49.00
Premium blende, basis 60 per cent zinc	$46.00@47.00
Prime Western, basis 60 per cent zinc	45.00
Fines and slimes, 60 per cent zinc	44.00@42.00
Average settling price, all zinc	44.74
Galena	
High	$95.25
Basis 80 per cent lead	90.00
Average settling price, all lead	94.66

Shipments for the week: Blende, 11,036; lead, 2,135 tons. Value, all ores the week, $695,900.

Shipment for five months: Blende, 356,248; lead, 52,055 tons. Value, all ores five months, $23,649,000. The average value exceeds one million dollars per week for the twenty-two weeks of the year closed today.

Tonnage shipped during the month was more than 25 per cent overload, compared with the tonnage reported purchased. The overload is usually estimated 12 to 15 per cent. The reported purchase was 55,270 tons and the shipment was 69,300 tons.

The policy of restriction is removed from choice to one of necessity on the part of a number of mines, closed down from lack of profit. The output for the week was only 13,110 tons, almost 7,000 tons less than the output in February.

There was exported during the month 3,900 tons of zinc concentrate through two purchasing representatives of European smelters.

On account of the low zinc prices, some operators are disposing of lead and witholding the zinc from the market.

Platteville, Wis., May 29, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$47.50
Lead Ore	
Lead, basis 80 per cent lead	$92.50

Shipments for the week: Blende, 939 tons; lead, 40 tons. Shipments for the year: Blende, 21,937; lead, 552 tons. Shipments for the week to separating plants, 1,700 tons blende.

Steel Steady—Pig Iron and Coke Dull

Pittsburgh, June 1, 1926

Steel-mill operations last week were at fully 80 per cent, the average during May being between 80 and 85 per cent. As summer is approached, production and shipments hold up better than a year ago and vastly better than two years ago. Steel-ingot production in the twelve months through May was about 1,250,000 tons greater than in the calendar year 1925, although that year made a new calendar-year record.

No stocks of steel have accumulated, and hence there is no reaction, as in previous years, on that account. Consumption has merely decreased slightly in some lines. Prospects are for some further decreases, though slight.

Mills have marked up prices on steel bars to 2.00c., Pittsburgh, for 100-ton lots, and 2.10c. for carloads, restoring prices which yielded recently. Sheets have grown still weaker, 3.10c. on black and 4.30c. on galvanized being not uncommon, and the general sheet market is scarcely above its level of last October. Other steel prices hold very well.

Pig Iron.—The Pittsburgh-Valley pig-iron market continues dull. Quoted prices are unchanged, but are only nominal, having had no recent test: Bessemer, $19.50; basic, $18.50; foundry, $19, f.ob. Valley furnaces.

Connellsville Coke.—The market continues dull, with spot at $2.85@$3 for furnace and $4@$4.50 for standard foundry. Some third-quarter business is under negotiation, at close figures.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £118 long ton. Domestic demand good.

Antimony — Per pound, New York, duty paid: Chinese brands, spot, 9½@10c.; July arrival, 9½c. Cookson's "C" grade, spot, 20c. Market mostly nominal.

Chinese needle, lump, 12c. Standard powdered needle, 200 mesh, 13c. White oxide, Chinese, 99 per cent Sb_2O_3, 15c. Nominal; little business, but outlook seems better.

Bismuth—$2.70@$2.75 per lb. in ton lots. London, 10s.

Cadmium—60c. per lb. London, 2s. 2d. for American metal; 1s. 9d. for Australian metal.

Cobalt—Shot, 96@98 per cent, $2.50@$2.75 per lb. Black oxide, 70 per cent, $2.10; gray oxide, 75 per cent, $2.25. London, 10s. for metal; 8s. for black oxide; 8s. 10d. for gray. Market for metal quiet; price nominal.

[1]**Germanium Oxide**—25 to 50 gm. lots, $6 per gm.

Iridium—$160@$170 per oz. for 98@99 per cent. Nominal. London, £63@£65 in iridio-platinum.

[1]**Lithium**—95@96 per cent grade in 1 to 5 lb. lots, $65 per lb.

Magnesium—Ingot, 75@80c. per lb. in ton lots, depending on quality; best 99.8 per cent. Quiet market; prices firm.

London, 3s. 9d.@4s. 3d. for 99 per cent ingots or sticks.

[1]**Molybdenum**—99 per cent, $25 per kg.; C. P. metal, $80 per kg.

Monel Metal — Base price for shot, 32c. per lb.

Nickel—Ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). Market less active than recently. London, £170@£175 per long ton, according to quantity.

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[1]Price furnished by Foote Mineral Co., Philadelphia.

Osmium—$80@$85 per oz.; London, £17@£20.

Palladium—$67@$69 per oz. Crude, $60@$65 per oz. London, £12@£15, nominal.

Platinum—Refined, $108 per oz. officially quoted. Sales also at $104@$105. Crude, $103.50. The market is rather demoralized, but the undertone is reported as better.

London, £22½@£23½ per oz. for refined, and £21 for crude. Demand limited.

Quicksilver—Per 75-lb. flask, $91.25@$91.50. London, £15. San Francisco wires $90.67. Market is firm.

Radium—$70 per mg. radium content.

Rhodium—$70@$80 per oz.; London, £14@£17. Nominal.

Ruthenium—$55@$65 per oz., nominal. London, £12@£15.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2 per lb. in ton lots.

Tantalum—$36 per pound.

Tellurium—$2 per pound.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $8 per lb. in 25-lb. lots.

Tungsten Powder—97 to 98 per cent pure, $1.18@$1.20 per pound.

[1]**Zirconium Metal**—98 per cent grade, per lb., $30, in 5 to 10 lb. lots.

Metallic Ores

Chrome Ore—Rhodesian, Indian, New Caledonian, 46-50 per cent, Cr_2O_3, $21@$23, c.i.f. Atlantic seaports; fair demand.

Iron Ore—Lake Superior ores, per long ton, lower Lake ports:

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range bessemer, 51½ per cent, $4.55.

High-phosphorus foundry, over 0.18 per cent P, $4.15.

Eastern ores, cents per unit delivered at furnaces: Foundry and basic, 53 to 63 per cent, 9@10½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

Swedish and Norwegian, low-phosphorus, 68 per cent, 10¼@10½c.

Spanish low-phosphorous, 52@54 per cent, 10@11c.

Algerian, low-phosphorus, 9¼@9¾c.

Spanish foundry or basic, 50@54 per cent, 8½@9½c.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

Foreign ore prices are generally off from ¼ to ½c. since a month ago.

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports: Brazilian, 40c., nominal; Indian, 40c., nominal; Caucasian (washed), 53 to 55 per cent, 40c.; market dull.

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80 per ton in carloads.

Molybdenum Ore—55c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates, f.o.b. mines. Largely nominal.

Tantalum Ore—Foreign, 55@65c. per lb. of Ta_2O_5 contained, c.i.f. New York.

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $10.50@$10.60; Western scheelite, $10.75@$10.85. Domestic demand very light, and prices largely nominal. Large stocks on hand but firmly held for advance in price.

Uranium Ore—Minimum 5 per cent U_3O_8, per pound of U_3O_8 contained, $5, f.o.b. Montrose, Colo.

Vanadium Ore—Containing 5 per cent V_2O_5 recently has sold at 30@35c. per pound of V_2O_5, f.o.b. Montrose, Colo. Market narrow.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 60@65c. per pound V_2O_5, duty paid, seaboard.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

Asbestos—F.o.b. *Quebec* mines, tax and bags included, per ton:

Crude No. 1, $525; crude No. 2, $300; spinning fibers, $190; magnesia and compressed sheet fibers, $125@$150; shingle stock, $70; paper stock, $40@$45; cement stock, $25; short fibers, $10@$17.50; floats, $15.

Production increased. Surplus of cement stock; some curtailment in this grade. Shipments about normal, with prices unchanged.

No. 1 Rhodesian crude, $325; No. 2, $250 per ton, c.i.f. New York. Market excellent, with principal producer well sold ahead.

Barytes—F.o.b. mines, per ton, bags extra:

South Carolina: Crude, $7@$8 per gross ton; ground, off color, $14@$17 per short ton.

North Carolina: White bleached, $22 per short ton; white natural, $20.

Georgia: Barytes ore, washed, $7.50. Demand only fair; rubber manufacturers curtailing production.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $8, f.o.b. mines. Market good.

Canada: 94@96 per cent $BaSO_4$, $9 per net ton, f.o.b. mine.

Bauxite — American, f.o.b. shipping point per gross ton: Crushed and dried, $5.50@$8.50; pulverized and dried, $14; calcined, crushed, $17@$20.

Foreign, per metric ton, c.i.f.: Dalmatian, low SiO_2. $5@$6.50; Istrian, $5.50@$7; French, red, $6@$7.50.

Prices are largely nominal, as contracts cover most of the 1926 deliveries.

Borax—Carload lots, in bags, per lb.: crystals, 5c.; granulated or powdered, 4¾c.; f.o.b. plant, *Illinois.*

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $27 per ton in carload lots.

Chalk—Crude, in bulk, per ton c.i.f. New York, $4.75@$5.

China Clay (Kaolin)—F.o.b. *Virginia* mines, per ton: crude, lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $10@$20; ground, $7@$10.

Georgia, washed lump, $8.65; *Florida,* washed lump. $13. Mineral flour, $20.

1A grades, domestic, $16@$18, f.o.b. *Delaware* plants. Market fair.

Imported English, f.o.b. American ports: Pottery, white ware, $19@$22; paper clay, $18. Coal strike has interfered with shipments.

Diatomite—Per short ton, f.o.b. plant, *California:*

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $30; natural aggregate, ¼ in., $20; air-floated powder, $40. "Calatom" (mill run), $14.50@$16 depending on quantity; market quiet.

Emery — F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 5½c.; domestic, 3½c. Market good.

Feldspar — F.o.b. mine or grinding plant:

North Carolina: No. 1 pottery grade, $6@$6.25 per long ton, depending upon quality. Market dull.

New Hampshire: No. 1, not over 10 per cent SiO_2, $8.50 per short ton; pottery grade, $7.50. Ground, $17. Market fair.

New York: Per ton, f.o.b. cars, No. 1 crude, $9. Market good.

Maine: No. 1, ground, $19 per ton. Market good.

Tennessee: No 1 pottery; 140 mesh, $16; 200 mesh, $18. No. 1 enamel, 140 mesh, $14; 200 mesh, $16. Market irregular.

Maryland: 140 mesh, $18@$22; 120 mesh, $16; 60 to 100 mesh, $12@$15.

Fluorspar—F.o.b. *Kentucky* and *Illinois* mines, per short ton:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50. Acid lump, 98-1, $30 in car lots. Acid ground packed in bags, $40@$45. Better tonnage moving than for several months. Strong competition.

New Mexico: 85-5 gravel, $15.75; 80-6 gravel, $15 f.o.b. mines. Ground, 96 per cent through 100 mesh, $35. Market good.

Fuller's Earth—Per ton, f.o.b. *Midway, Fla.:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 60 to 100 mesh, $15; 100 mesh "up," $8; 200 mesh "up," $15. Market fair.

Powdered, imported, duty paid, $23@$25 per ton.

Garnet — Domestic, per ton f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry.

Gilsonite—Per ton, carload lots, f.o.b. mines *Colorado:*

Jet asphaltum, $36; selects, $33; seconds (ordinary grades), $25.50; peerless black, $32.90. Market normal.

Graphite—F.o.b. New York, per lb.:

Ceylon lump, 8½@9¾c.; chip, 7@8c.; dust, 3½@6½c. Madagascar flake, 7½@8½c.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Market dull; prices for imported product lower.

Flake, 10@20c. according to grade; fine ground crystalline, 7@10c.; amorphous ground graphite, 4@8c. Crude amorphous graphite, $15@$35 per ton according to grade. Market easier.

Greensand—Per ton, f.o.b. cars, *New Jersey:* screened and bagged, best grade in carload lots, $30. Shipments in smaller volume.

Gypsum—Per ton f.o.b. mill, depending upon location: Crushed, $2.75@$3.50; ground, $4@$6; agricultural, $6@$11; calcined, $8@$13.

[1]**Ilmenite**—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. *Virginia* points. $60 per short ton, *Florida* mines.

Iron Oxide (See Ocher)—Standard Spanish red, 3@4c. per lb.; domestic earth, 2@4½c.

Kaolin—See China Clay.

[1]**Lepidolite**—$20@$30 per ton for ordinary grades. Nominal.

Limestone—F.o.b. shipping points, depending on location: crushed, ½ in. and less, 90c.@$2; 3 in. and larger, 90c.@$1.80 per ton.

Agricultural, $1@$5 for pulverized; 75c.@$2 for crushed. Prices depend upon source, purity, and fineness.

Magnesite—Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $40@$45; dead burned, $35; crude, $14. Market good.

Mica—F.o.b. plant, per ton:

North Carolina: 20 mesh, roofing, $38; 100 mesh, white ground, $70. Market fair.

New Hampshire: Mine run, $380, clean shop scrap, $25; mine scrap, $20. White, dry ground, 20 mesh, $35; 40 mesh, $45; 60 mesh, $60; 100 mesh, $75; 200 mesh, $85. Market fair.

Madagascar, amber, dark, free from iron, per lb., f.o.b. *New York*, duty paid: special grade, $3@$3.25; No. A 1, $2.75; No. 1, $2.50; No. 2, $2.20; No. 3, $1.20; No. 4, 60@70c. No. 5, 42@45c. Grades depend on size of sheets. Market slow.

[1]**Monazite**—Minimum 6 per cent ThO_2, $120 per ton.

Ocher — F.o.b. *Georgia* mines, per ton: $22.50@$25 in sacks; $25@$30 in barrels; washed and water floated, $25@$28; second grade, 99 per cent through 225 mesh, $19. Market good.

Phosphate—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10. Market firm with good demand especially for the lower grades.

Florida, pebble, domestic: 76@77 per cent, $6; 75 per cent, $5.25; 74@75 per cent, $5; 70 per cent, $3.50; 76@78 per cent special, $6.50. Market dull but prices firm.

Tennessee, lump, ¾-in. screen, base 75 per cent, $6. Ground, 95 per cent through 100 mesh, base 65 per cent, $7.25; 70 per cent, $8.25. Market slow, but orders for fall shipment are good.

Potash—	Bags	Bulk
Muriate of potash 80@85 per cent, basis 80 per cent....	$34.90	$33.65
Sulphate of potash 90@95 per cent, basis 90 per cent....	45.85	44.60
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	26.35	25.10
Manure salt 30 per cent....	21.00	18.00
Manure salt 20 per cent....	14.85	11.85
Kainit 14@16 per cent.....	11.75	8.75
Kainit 12.4 per cent.....	11.25	8.25

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

Discounts: 5 per cent on minimum of 50 tons K_2O; 6 per cent on 100 tons; 7 per cent on 300 tons; 10 per cent on 500 tons. Prices guaranteed against sellers' decline until April 30, 1927.

Pumice Stone—In barrels, per lb., powdered, 2½@4c.; selected lumps, 5@7c.; lumps in bags, 3@5c.

Pyrites—Tharsis, per long ton unit of sulphur, c.i.f. U. S. ports; guaranteed 48 per cent sulphur, furnace size, 13½c. Cinder from ore to remain property of buyers. Market improving.

[1]**Quartz Rock Crystals**—Colorless, clear and flawed, pieces ½ to ½ lb. in weight, 40c. per lb. in ton lots. For optical purposes, double above prices.

Rutile—*Virginia*, per lb.; granular, 94@96 per cent TiO_2, 12@15c.; pulverized, 100 mesh, 94@96 per cent, 17@30c.

Florida 93 per cent TiO_2, $200 per ton.

Silica—Water ground and floated, per ton in bags f.o.b. *Illinois:* 450 mesh, $31; 350 mesh, $26; 250 mesh, $18.

Glass sand, f.o.b. producing plant, $1.25@$5 per ton; brick and molding sand, 40c.@$2; blast sand, $2@$4.50.

[1]**Spodumene**—$20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$18 per ton for domestic, f.o.b. *Texas* mines; $22 for export, f.a.s. Atlantic ports. Good shipment against contracts. Open prices $1 higher.

Talc—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $11; 96 per cent through 200 mesh, medium white, $10; packed in 50-lb. paper bags. Demand fair, buyers reluctant to anticipate requirements.

New York: Double air-floated, 100 mesh, $11.25; 200 mesh, $13.75; 325 mesh, $14.75. Demand fair.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9. Market fair.

New Jersey: Soapstone, ground, $8.50@$11; market good.

Tripoli—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri*: Once ground through 40 mesh: rose and cream colored, $16. Double ground through 110 mesh: rose and cream, $17. Air-floated through 200 mesh: rose and cream, $25; mill run, $15. Seasonal slackness.

[1]**Zircon**—Freight allowed east of Mississippi River: 95 per cent, 3c. per lb., f.o.b. mines, in carload lots.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Mineral Products

Arsenious Oxide (white arsenic)—3½c. per lb. Market continues dull. London, £14½@£15 per long ton.

Copper Sulphate — Large crystals, 4.75@4.95c. per lb. depending on quantity; small crystals, same.

Sodium Nitrate, spot, crude $2.60 per 100 lb. ex vessel Atlantic ports. Futures, 2.45@$2.60.

Sodium Sulphate (Salt Cake)—Per ton, bulk, f.o.b. works, $20@$22.

Zinc Oxide—Per lb. in bags, in car lots: Lead-free, 7½c.; 35 per cent leaded grades, 7½c.; French, 10½c.

Ferro-Alloys

[1]**Ferrocerium**—Per pound, $5.50.

Ferrochrome—1@2 per cent carbon, 23@25c. per lb. of contained chromium; 4 to 8 per cent carbon, 10½@11½c. per lb.; 0.1 per cent, 35c. per pound. Market fair.

Ferromanganese — Domestic, 78@82 per cent, $88@$90 per gross ton. British product held at $110, seaboard, duty paid. Spiegeleisen, 19@21 per cent, $33 f.o.b. furnace; 16@19 per cent, $32. No demand for spot; trading slow on account of prospective curtailment in consumption.

Ferrophosphorus—Electrolytic, 18 per cent P, $91 per ton; 24 per cent, $122.50; f.o.b. Ala. and Tenn.

Ferrosilicon—Per gross ton, f.o.b. works: 50 per cent, $87.50 delivered in carload lots; 75 per cent, $145. Market fair.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — $1.05@$1.10 per lb. of contained W, f.o.b. works, according to grade.

[1]**Ferro-uranium**—30 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works in 500-lb. lots.

Ferrovanadium — Per lb. of V contained, f.o.b. works, $3.25@$4, depending on grade and delivery.

Metal Products

Rolled Copper—Sheets, 22½c.; wire, 16c.

Lead Sheets — Rolled, 11½c.; clipped, 11¾c.

Nickel Silver—29½c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal — Dimension sheets, 19¾c. per lb.; rods, 16¾c. per lb.

Zinc Sheets — 11.25c. per lb., f.o.b. works.

Refractories

Chrome Brick—$45 per net ton, f.o.b. shipping point.

Fireclay Brick—First quality, $40@$43 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $35@$38.

Magnesite Brick—9-in. straights, $65 per net ton, f.o.b. works.

Silica Brick—$40 per M. Pennsylvania and Ohio; $48@$52 Alabama.

[1]**Zirkite**—Powdered, 80 per cent ZrO_2, 2½c. per lb. Brick, straights, 80c.@$1 each.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1925	1926	1925	1926	1925	1926
January	68.447	67.795	32.197	31.322	477.702	485.295
February	68.472	66.773	32.245	30.797	476.886	485.852
March	67.808	65.880	31.935	30.299	477.279	485.606
April	66.899	64.409	31.372	29.682	479.034	435.702
May	67.580	65.075	31.276	30.125	484.960	485.485
June	69.106	.....	31.863	.....	485.353	.....
July	69.442	.....	31.954	.....	485.514	.....
August	70.240	.....	32.268	.....	485.264	.....
September	71.570	.....	32.983	.....	484.270	.....
October	71.106	.....	32.972	.....	483.909	.....
November	69.223	.....	32.155	.....	484.201	.....
December	68.889	.....	31.835	.....	484.538	.....
Year	69.065	.....	32.088	.....	482.426	.....

New York quotations cents per ounce troy, 999 fine, foreign silver. London pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1925	1926	1925	1926	1925	1926
January	14.709	13.822	66.065	59.013	70.607	65.325
February	14.463	13.999	64.714	59.669	69.525	66.375
March	14.004	13.859	62.892	58.603	67.739	65.489
April	13.252	13.706	60.575	57.200	64.194	64.600
May	13.347	13.599	60.131	56.494	63.560	64.313
June	13.399	.....	59.899	.....	63.369	.....
July	13.946	.....	61.467	.....	65.750	.....
August	14.490	.....	61.613	.....	68.169	.....
September	14.376	.....	61.886	.....	67.693	.....
October	14.300	.....	61.977	.....	67.523	.....
November	14.353	.....	61.280	.....	67.893	.....
December	13.866	.....	59.540	.....	65.625	.....
Year	14.042	.....	61.920	.....	66.804	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London		
	1925	1926	1925	1926	1925	1926	1926 3 M
January	10.169	9.255	9.953	9.102	41.443	34.778	34.584
February	9.428	9.154	9.126	8.991	37.944	33.903	33.903
March	8.914	8.386	8.578	8.165	36.804	31.625	31.921
April	8.005	7.971	7.662	7.764	32.791	28.775	29.284
May	7.985	7.751	7.780	7.538	32.283	28.253	28.731
June	8.321	.....	8.024	.....	33.479	.....	.....
July	8.151	.....	8.054	.....	34.698	.....	.....
August	9.192	.....	9.284	.....	38.188	.....	.....
September	9.508	.....	9.303	.....	38.884	.....	.....
October	9.513	.....	9.299	.....	39.017	.....	.....
November	9.739	.....	9.578	.....	36.872	.....	.....
December	9.310	.....	9.157	.....	34.739	.....	.....
Year	9.020	.....	8.817	.....	36.429	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1925	1926	1925	1926	1925	1926
January	57.692	61.415	58.250	2.275	265.560	282.038
February	56.517	62.653	57.068	63.705	262.181	287.107
March	53.038	63.472	53.733	64.505	245.682	292.288
April	51.380	61.962	52.135	63.389	237.006	281.388
May	53.675	60.165	54.620	62.305	245.476	270.125
June	54.885	.....	55.957	.....	252.476	.....
July	56.683	.....	58.014	.....	258.435	.....
August	56.649	.....	58.190	.....	258.538	.....
September	56.405	.....	58.247	.....	259.182	.....
October	60.462	.....	62.274	.....	277.722	.....
November	62.136	.....	63.304	.....	284.506	.....
December	61.952	.....	62.928	.....	284.920	.....
Year	56.790	.....	57.893	.....	260.974	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London		
			1925		1926
	1925	1926	Spot	1926	3 M
January	7.738	8.304	37.917	38.059	37.363
February	7.480	7.759	36.528	36.053	35.956
March	7.319	7.332	35.741	34.090	34.247
April	6.985	7.001	34.644	32.503	32.863
May	6.951	6.821	34.223	32.038	32.413
June	6.990	.....	34.149	.....	.....
July	7.206	.....	34.894	.....	.....
August	7.576	.....	36.691	.....	.....
September	7.753	.....	37.435	.....	.....
October	8.282	.....	39.884	.....	.....
November	8.614	.....	39.039	.....	.....
December	8.565	.....	38.327	.....	.....
Year	7.622	.....	36.624	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York
	1925	1926	1925	1926	1925	1926	1926
January	17.428	23.490	81.596	87.960	117.000	118.200	113.20
February	19.795	21.676	79.386	87.580	117.000	113.909	108.341
March	15.553	19.708	80.481	88.194	117.000	112.000	106.278
April	12.553	17.462	82.327	89.769	118.269	111.538	103.731
May	15.770	12.170	81.360	91.335	119.850	108.960	102.900
June	16.500	.....	83.154	.....	120.000	.....	.....
July	17.779	.....	83.077	.....	120.000	.....	.....
August	17.683	.....	82.317	.....	120.000	.....	.....
September	17.143	.....	81.730	.....	120.000	.....	.....
October	18.029	.....	83.856	.....	120.000	.....	.....
November	20.000	.....	88.250	.....	120.000	.....	.....
December	21.692	.....	90.000	.....	120.000	.....	.....
Year	17.494	.....	83.128	.....	119.093	.....	.....

(a) Antimony quotations in cents per pound for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1925	1926	1925	1926	1925	1926
January	24.66	22.76	23.76	21.76	23.76	22.26
February	24.50	22.76	23.26	21.76	23.76	22.26
March	24.06	22.76	23.06	21.76	22.91	22.26
April	22.89	21.38	21.76	20.66	22.26	21.05
May	21.57	.....	20.26	.....	21.16	.....
June	20.76	.....	19.76	.....	20.11	.....
July	20.76	.....	19.76	.....	20.26	.....
August	20.76	.....	19.76	.....	20.26	.....
September	21.04	.....	20.03	.....	20.50	.....
October	21.50	.....	20.37	.....	20.83	.....
November	22.64	.....	21.58	.....	22.08	.....
December	22.76	.....	21.76	.....	22.26	.....
Year	22.33	.....	21.26	.....	21.68	.....

In dollars per long ton.

Monthly Crude Copper Output in Short Tons

Domestic

	1925		1926			
	Nov.	Dec.	Jan.	Feb.	March	April
Alaska shipments	4,677	2,880	3,644	2,556	3,150	3,597
Butte & Superior	.....	.....	.....	.....	1,243†	.....
Calumet & Arizona	2,070	1,682	1,737	1,795	2,010	1,938
Magma	.....	.....	1,208	1,095	1,255	1,200
Miami	2,090	2,112	2,228	2,109	2,336	2,302
New Cornelia	2,150	3,604	3,664	2,986	3,641	3,634
Nevada Con.	....	9,777†	....	.....	9,774†	.....
Old Dominion	958	1,217	1,291	1,080	1,111	1,132
Phelps Dodge	6,500	6,957	7,586	6,949	7,440	7,033
Ray Con	....	18,025†	....	.....	17,840†	.....
United Verde Extension	1,632	1,874	1,987	1,764	1,784	1,730
Utah Copper	....	26,723†	....	.....	26,736†	.....
Tennessee Copper	573	604	555	503	543	520

Foreign

Boleo, Mexico	798	773	771	820	898	893
Furukawa, Japan	1,349	1,579	1,409	1,386	1,586	.....
Granby Cons., Canada	1,396	1,927	1,438	1,482	1,763	1,583
Katanga, Africa	8,207	6,703	6,827	6,810	7,097	7,050
Mount Lyell, Aust.	....	1,805†	....	.....	2,002†	.....
Sumitomo, Japan	1,553	1,683	1,188	.....	.....	.....

†Three months.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1924		1925		1926	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	66,631	2,149	74,789	2,412	71,026	2,291
February	65,681	2,265	68,967	2,463	68,131	2,433
March	65,181	2,102	74,901	2,416	75,728	2,443
April	66,073	2,202	70,667	2,356	73,006	2,434
May	65,608	2,116	70,574	2,276	.....	.....
June	63,933	2,131	59,894	2,330	.....	.....
July	64,787	2,090	68,507	2,210	.....	.....
August	66,756	2,153	68,090	2,196	.....	.....
September	63,800	2,127	67,720	2,272	.....	.....
October	68,989	2,225	71,042	2,292	.....	.....
November	68,291	2,276	67,400	2,247	.....	.....
December	67,647	2,182	69,566	2,244	.....	.....
Total	793,377	.....	842,117	.....	287,891	.....
Monthly average	66,115	.....	70,176	.....	71,973	.....
Average of daily rate	.....	2,168	.....	2,307	.....	2,399

Utah Copper's Quarter

The Utah Copper Co. during the first quarter of 1926 produced copper from all sources as shown below:

	Pounds Copper	Monthly Average
1926—Quarter ended March 31	53,472,436	17,824,125
1925—Quarter ended Dec. 31	53,446,623	17,815,541

During the quarter the Arthur plant treated 1,441,500 dry tons of ore and the Magna plant 1,669,600 dry tons, a total for both plants of 3,111,100. The average grade of ore treated at the mills was 1.01 per cent copper and the average mill recovery of copper in the form of concentrates was 88.72 per cent of that contained in the ore, as compared with 0.99 per cent copper and 88.24 per cent recovery, respectively, for the previous quarter.

Average cost per net pound of copper produced, including depreciation of plant and equipment and all fixed and general expenses, and after crediting gold, silver, and miscellaneous earnings, was 8.9c., compared with 8.6c. for the preceding quarter, computed on the same basis.

The following tabulation shows the financial results:

	First Quarter 1926	Fourth Quarter 1925
Net profit from copper production	$2,519,419.48	$2,812,489.70
Miscellaneous income, including gold and silver	589,014.34	651,736.88
Bingham & Garfield Railway Co. dividend	75,000.00	75,000.00
Nevada Consolidated Copper Co. dividend	250,125.00	250,125.00
Total income	$3,433,558.82	$3,789,351.58
Depreciation	303,701.16	311,648.35
To surplus	$3,129,857.66	$3,477,703.23

New Jersey Zinc Co.

The New Jersey Zinc Co. for the quarter ended March 31, 1926, reports as follows:

Income (including dividends from subsidiary companies) after deductions for expenses, taxes, maintenance, repairs, depreciation, depletion and contingencies	$1,723,896.01
Deduct	
Interest on first mortgage bonds	40,000.00
Net income	$1,683,896.01
Deduct	
Dividend 2 per cent, payable May 10, 1926	981,632.00
Surplus for the quarter	$702,264.01

Howe Sound Company

Results of the operation of the properties of the Howe Sound Co. for the quarter ended March 31, 1926, were:

Production	Gold, Ounces	Silver, Ounces	Copper, Pounds	Lead, Pounds,	Zinc, Pounds
First quarter, 1926	1,844	576,922	8,227,371	12,748,969	9,517,392
Fourth quarter, 1925	2,982	526,669	8,252,264	9,973,348	8,477,780

Financial	First Quarter, 1926	Fourth Quarter, 1925
Value of metals produced	$3,317,347.95	$2,998,536.54
Operating costs	2,476,457.52	2,220,169.59
Operating income	$840,890.43	$778,366.95
Miscellaneous income	38,583.33	127,563.57
Total income	$879,473.76	$905,930.52
Less depreciation	184,942.57	241,187.71
Net income	$694,531.19	$664,742.81

Imports and Exports of Ores and Metals in April, 1925 and 1926

Compiled from the U. S. Department of Commerce Records

In pounds unless otherwise specified

Imports

	April 1925	April, 1926
Antimony		
Ore, Gross weight	197,382	506,117
Ore, Antimony content	89,430	414,973
Liquated regulus or metal	2,103 880	3,307,618
Copper		
Ores	7,277,504	3,601,171
Concentrates	10,713,426	2,236,136
Regulus, coarse metal and cement copper	131,817	996,524
Imported from		
Spain	593,376	143,360
Canada	559,123	3,261,837
Mexico	1,962,210	2,262,361
Cuba	8,379,977	.....
Chile	6,289,233	102,669
Peru	16,393	341,053
Other countries	322,435	722,551
Unrefined, black, blister and converter copper in pigs	40,255,461	51,713,983
Imported from		
Canada	2,351,945	5,439,811
Mexico	5,835,128	5,067,787
Chile	12,982,578	9,387,540
Peru	1,473,674	7,949,819
Portuguese Africa	17,612,136	7,858,085
Other countries	.....	16,010,941
Refined copper	7,809,898	10,242,855
Old and clippings for remanufacture	688,082	1,883,556
Composition metal, copper chief value	112	.....
Brass		
Old and clippings for remanufacture	521,878	492,610
Lead		
Ore and matte	7,659,057	6,784,895
Bullion or base bullion	15,263,802	15,812,166
Pigs and bars	102,429	1,126,332
Scrap lead, babbitt metal, solder and other forms (lead content)	361,188	114,714
Type metal and antimonial lead, Gross weight	166,613	892,586
Type metal and antimonial lead, Lead content	133,298	857,046
Manganese ore, tons, Gross weight	248	90
Manganese ore, tons, Manganese content	14,941	55,047
Pyrites	20,479	6,365
Tin		
Ore, tons	13	77
Bars, blocks and pigs	10,430,188	13,243,679
From		
United Kingdom	2,677,233	4,427,709
British Malaya	6,589,176	7,359,393
China	.....	33,640
Dutch E. Indies	23,385	58,566
Hongkong	620,966	123,423
Australia	93,600	212,800
Other countries	425,878	1,028,148
Zinc		
Ore, zinc content	5,880,155	2,243,331
Blocks, pigs, and old	.....	1,566

Exports of Copper, Lead and Zinc

	April, 1925	April, 1926
Copper		
Ores, concentrates, composition metal, and unrefined	.....	999,677
Refined in ingots, bars, and other forms	98,697,927	83,923,534
Exported to		
Belgium	8,096,364	8,816,668
France	15,138,619	18,574,725
Germany	22,421,857	14,558,878
Italy	10,213,386	8,538,344
Netherlands	13,120,799	4,853,945
Spain	325,011	728,523
Sweden	2,636,958	2,221,711
United Kingdom	20,842,932	15,098,064
Other Europe	1,178,273	504,860
Canada	1,339,358	1,098,625
British India	.....	1,176,734
China	2,620,800	2,408,000
Japan	223,789	5,032,574
Other countries	539,781	311,883
Old and scrap	675,659	910,176
Pipes and tubes	202,804	258,496
Plates and sheets	1,248,655	507,222
Rods	5,666,839	2,945,386
Wire	821,835	1,307,763
Insulated copper wire and cable	1,671,303	2,088,044
Lead		
In pigs, bars, and other forms		
From domestic ore	695,224	3,716,426
From foreign ore	30,030,607	9,450,832
Exported to		
Belgium	560,215	448,113
France	1,053,169	2,464,595
Germany	6,132,945	3,786,578
Netherlands	1,162,436	336,098
United Kingdom	19,378,986	2,408,694
Other Europe	784,360	840,373
Argentina	629,585	15,259
Brazil	338,475	448,096
Japan	.....	1,456,475
Other countries	685,660	962,977
Other lead manufactures	1,006,527	3,215,370
Zinc		
Ore and concentrates, tons	.....	20,030
Dross	2,363,809	2,163,468
Cast in slabs, blocks or pigs	10,604,825	6,315,893
Exported to		
Belgium	560,030	336,022
France	1,943,355	1,064,084
Germany	1,338,156	832,222
Italy	1,568,495	224,013
Netherlands	593,637	.....
United Kingdom	3,773,477	672,295
Other Europe	291,220	336,038
Argentina	56,914	.....
British India	168,074	1,232,217
Other countries	311,467	1,619,002
In sheets, strips and other forms	597,037	697,185
Dust	447,144	158,570
Other zinc manufactures	56,674	178,987